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CONTRACT REPORT

To evaluate the effect of pinching technique and substrate type on the growth, development and shelf-life of poinsettia

HDC 71b

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

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CONTENTS

3. Results

A - Main Trial HRI Efford

B - Subsidiary Trial HRI Efford and HRI Littlehampton

C - Commercial Trials

List of Appendices

Final Report March 1996

HDC PC71b

To evaluate the effect of pinching technique and substrate type on the growth, development and shelf-life of poinsettia

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1. RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

1.1 APPLICATION

All three specialist Poinsettia substrates evaluated, ICI, Stender and EGO, produced plants of acceptable quality at marketing. Each media type varied in its composition, although the ICI and EGO mixes were similar. It is important that the correct irrigation and nutritional regimes are adopted in order to optimise the performance of each media type.

The use of controlled release fertilisers (CRFs) at the rates used prevented any manipulation of the nutritional regime, and it was found as a consequence that the higher nutrient levels reduced plant vigour. Plants remained more compact and their overall quality was reduced at marketing. The management of nutrition through liquid feeding provided more flexibility, and it would be recommended to use CRFs at rates below 5 kg/m^3 and use liquid feeds to supplement the CRFs if necessary. High levels of nutrient in the substrate at potting also caused a reduction in plant size. This was shown in plants grown in Stender which had a higher nutrient base at potting.

There was no effect of either media type or nutrition on the shelf-life of the plants. All plants remained of average quality throughout shelf-life. Increasing the duration of sleeving caused greater leaf drop and yellowing, and also cyathia loss. Bract quality was not affected by sleeve duration.

The use of Atrinal as a chemical pinching agent proved successful in that it stopped extension growth of the main stem and promoted lateral branching, but it severely reduced plant growth in the early stages of production and final plant size was reduced at marketing. It is not recommended for commercial use at this stage.

The effect of pinching date on floral initiation appeared to indicate that early pinching caused a slight delay in flower development, but which was not thought to be of any commercial significance. There was no consistent difference in plant breaking action between plants pinched early (soft) or late (hard). Pinching early did produce more vegetative growth and plants were slightly larger in size at marketing than those pinched later, but again differences were very small.

The commercial evaluation of new cultivars demonstrated the wide range of colours and forms of Poinsettia now available for commercial production. The cultivars Flirt, Sonora and Puebla were perceived to have better shelf-life, although Noblestar and Cortez were noted for their quality at marketing.

1.2 SUMMARY

The commercial production of Poinsettia can be influenced by a wide range of cultural factors. The aim of this study was to examine the effect of media type and nutrition on the growth, flowering and shelf-life of Poinsettia. Three specialist Poinsettia growing media were evaluated using either a standard liquid feed programme or the use of controlled release fertilizers as a complete replacement of liquid feeding. Three cultivars were grown; Lilo, Freedom and Red Sails.

In addition, the effect of pinching date on floral initiation and development was assessed. Potentially the time of pinching will influence both the growth and appearance of the final product at marketing, and it was unknown what the effect of pinching date would have on flower development. Therefore an early and late pinching treatment was imposed.

Manually pinching Poinsettias is very labour intensive and as part of this study, the use of *dikegulac* as Atrinal was evaluated as an alternative chemical pinching method.

Finally, commercial trials in addition to the main study at Efford were conducted on one commercial holding to evaluate the practical effect of pinching date on plant growth and to evaluate new cultivars under commercial conditions. The plants were included in shelf-life assessments at HRI Efford.

The shelf-life trials at Efford included both an assessment of the use of calcium sprays in the prevention of bract edge necrosis, and also the effect of sleeve duration on the shelf-life of Poinsettia.

1.2.1 METHODOLOGY

A Main Trial HRI Efford

Site

Plants were grown in six compartments of the multifactorial glasshouse K-block at HRI Efford. Three of the compartments were benched with capillary matting whilst the other three compartments were flood floors.

Plants grown to evaluate the use of Atrinal as a chemical pinching agent were grown in the single glasshouse, P-block.

Plants grown to assess the effect of pinching date on floral initiation and development were grown in two compartments of the glasshouse K-block.

Start Material

Three main cultivars were grown:

Red Sails	(Eckespoint)
Freedom	(Eckespoint)
Lilo	(Eckespoint)

plus

Menorca	(Dümmen)
Ria	(Gross)
Marlene	(Dümmen)

which were grown for assessment as part of the initiation studies.

All plants were supplied as rooted cuttings from Dümmen through Hollyacre Plants Limited.

Treatments

Substrate: 3 types of specialist Poinsettia media were trialled:

A. ICI (UK)
B. Stender (Germany)
C. EGO (Netherlands)

Nutrition: A standard liquid feed programme was used in comparison to the use of controlled release fertilizer:

Osmocote Plus 5-6 months 15:10:12 + 2 Mg plus trace elements at 5 kg/m^3.

Pinching: A late pinch was compared to pinching early. All plants were pinched at 5-6 leaf nodes.

Early (soft) pinch - plants pinched 10 days after potting
Late (hard) pinch - plants pinched 18 days after potting

Use of a chemical pinching agent:

In a separate evaluation the use of *dikegulac* as Atrinal was compared against a standard manual pinching method.

Rates of Atrinal used applied 10 days after potting:

i. 10 ml/l
ii. 20 ml/l
iii. 30 ml/l

All plants were sprayed until run-off, and plants were subsequently shaded using woven fleece for 7-10 days.

Pinching treatments on initiation

2 compartments of K-block, K6 (NS) and K9 (NBL)

i. NS induction, pinching 23 days before equinox - 3 weeks after potting

ii. NBL induction, pinching 23 days before 2 October - 5 weeks after potting

iii. (Control) NBL induction (Main Trial)
1 - pinch 41 days before 2 October - 10 days after potting
2 - pinch 33 days before 2 October - 18 days after potting

Cultivars: Red Sails, Freedom and Lilo = pinching treatments i), ii) and iii)
Ria, Marlene and Menorca = pinching treatments i) and ii only

Shelf-life:

Plants of each cultivar from each of the media x nutrition treatments were evaluated in shelf-life. Two further sub-treatments were examined in shelf-life.

Calcium sprays to prevent bract edge necrosis

i. plants sprayed at 50% colour with 400 ppm calcium chloride
ii. control - plants were sprayed with plain water only

Sleeve duration

i. plants remained sleeved for 5 days in shelf-life
ii. plants remained sleeved for 10 days in shelf-life

Commercial Trials

Trial One

Objective: To assess the effect of early and late pinching on Poinsettia growth.

Cultivar: Red Sails (Eckespoint).
Supplied as rooted cuttings from Hollyacre Plants Limited.

Treatments: Pinched 'a' 7 days after potting on 26 August
Pinched 'b' 14 days after potting on 2 September

Trial Two

Objective: To assess a range of new Poinsettia cultivars for commercial production in the UK.

Cultivars:

***Fischer* cultivars**	**Colour**
Bonita	Red
Cortez	Red
Flirt	Pink
Noblestar	Dark Salmon
Picacho	Red
Puebla	Pink Cream edge
D. Puebla	Pink Cream edge
Sonora	Red

1.2.2 RESULTS

Plant growth was reduced in substrates augmented with CRFs. Plants were more compact in their habit and required closer spacing in the later stages of growth to increase plant height so that they would meet the minimum specification in height (26 cm). A similar response was recorded for plants grown in Stender which had a higher base nutrient content. There was no effect of media treatments on the breaking action of plants. Bract size at marketing was reduced in plants grown using CRFs.

In shelf-life there were no obvious differences between media or nutritional treatments, all plants remaining of good quality throughout shelf-life. Observations beyond the 4 week shelf-life assessments showed that plants grown in CRF tended to re-shoot from the bract heads. This was particularly noticeable with the cultivar Red Sails.

Sleeving plants for 10 days as opposed to 5 days in shelf-life caused greater leaf drop and yellowing and cyathia loss. The use of calcium sprays had little effect on the level of bract edge necrosis. Levels were very low on untreated plants. Nevertheless, the cultivars Freedom and Red Sails which had been sprayed with calcium chloride at first colour had slightly less bract necrosis.

The effect of spray application of Atrinal in order to 'chemically' pinch plants caused a severe reduction in plant growth immediately after treatment in comparison to plants which had been manually pinched.

Atrinal at the rate of 20 ml/l successfully promoted lateral branching and development of side shoots, whilst stopping extension of the main stem. There was no effect on flowering, and plants developed without any long-term damage although their final size was reduced at marketing.

The initiation studies showed the early development of Lilo and Freedom in comparison to the other cultivars. The estimated dates for natural season induction are Lilo 23/24 September, Menorca 22/23 September, Freedom 21/22 September, Red Sails 24 September, Marlene 24/25 September and Ria 25/26 September. Pinching plants early caused a delay in flower development in comparison to plants pinched late. In all cases the cultivars appeared to have initiated later in 1994, compared to the previous seasons, 1992 and 1993. The effect of NBL was to delay plant maturity by around 10-12 days, nearer to the main marketing period at Christmas. The use of NBL did cause a slight increase in the vegetative growth of the plant, showing the influence of the extended growth phase under photoperiodic lighting.

The commercial trials showed that plants pinched earlier were slightly larger than those pinched later. Similarly the number of bracts and their size were increased. There was very little difference in the number of bracts between plants pinched early or late.

The commercial evaluation of new cultivars further demonstrated the wide range of cultivars now available.

Sonora and Cortez did not break as freely as the other cultivars. At marketing all the cultivars were very compact and below the minimum height specification of 26 cm, but this was probably a consequence of their growing environment amongst a larger commercial crop. Plant growth was generally uniform with the exception of Cortez which was much broader in its habit. Bonita was slightly taller and had a greater number of bracts whilst Cortez, Flirt and Puebla had, on average, only 4 bracts at marketing. Bract size varied with cultivars; Cortez with the largest, 29 cm, and Puebla the smallest, 22 cm. The cultivars Sonora, Flirt and Puebla generally had a better shelf-life in comparison to the other cultivars.

1.2.3 CONCLUSIONS

- Specialist media types were successfully used in the production of Poinsettias, but each requires a separate cultural/management practice to optimise its performance.

- CRFs as used in the context of this trial produced more compact plants.

- Liquid feeding Poinsettias allowed a more flexible nutrient regime to be adopted.

- Pinching date will affect plant habit; pinching earlier has the potential to produce a bigger plant and there was an indication that flower development could also be delayed.

- Atrinal was successfully used as a chemical pinching agent on Poinsettias as a substitute for manual pinching, but gave a severe check to subsequent plant growth resulting in smaller plants at marketing.

- The length of time plants remained sleeved affected both leaf drop/yellowing and cyathia loss in shelf-life. Plants suffered greater deterioration when sleeved for 10 days.

- The range of new cultivars trialled on a commercial nursery showed considerable potential for commercial production demonstrating a greater range of colours, forms, and more compact habits.

- Use of NBL can be used to delay the maturity of plants closer to the Christmas market, but additional chemical plant growth regulation may be required to control the resultant increase in vegetative growth.

2. EXPERIMENTAL SECTION

2.1 INTRODUCTION

In 1994 it was estimated that 3.5 million Poinsettias were grown in the UK (MAFF statistics, 1994) and this figure is probably an underestimate of the true figure. Poinsettias are marketed over a very short 'window' at Christmas with sales concentrated in the two weeks preceding Christmas. The Poinsettia market at Christmas is an important sales period for ornamental growers, who often rely on the income from this period to ensure cash flow throughout the year.

Euphorbia pulcherrima Willd., the Poinsettia, is a member of the Euphorbiaceae family and the commercial varieties grown today originate from plants native to Mexico. The word 'Poinsettia' originated from Joel Robert Poinsett who first introduced the plants into the United States in 1825. Breeding work both in the United States and later in Europe have gone on to produce the cultivars grown commercially today.

Plant breeding has gone a long way to producing a suitable plant for commercial production in terms of habit, size and 'flowering'. However, the growth of Poinsettia can be influenced by a wide range of factors during commercial production; temperature, light, humidity, nutrition etc. Research continues in an attempt to understand the influence of cultural factors on the growth and flowering of Poinsettias, but growers still view the Poinsettia as potentially one of the most difficult crops to produce commercially. Cropping time can be in excess of 20 weeks for larger specimens, and throughout this period growers must pay particular detail to all the cultural practices adopted.

In 1993 the HDC funded a trial at HRI Efford to examine the influence of humidity and subsequently the use of calcium sprays to prevent or reduce the incidence of bract edge burn. This can be a serious problem late in production and often during marketing whereby the red bracts turn brown/black at their edges. The condition is thought to be due to a lack of calcium in the bracts which could be caused by a general low level of calcium in the plant tissues or by humidity levels which could affect calcium uptake and transportation. The results from this trial are presented in the HDC final report PC71a.

In 1994, the theme of plant quality and shelf-life was continued in trials funded by the HDC at HRI Efford. A number of cultural factors were evaluated in production and also in shelf-life.

To date in the UK, little attention has been paid towards substrate type and nutritional effects on plant growth of Poinsettia and subsequently in shelf-life. Nutrition and substrate type can have a strong effect on plant growth and may influence the incidence of bract edge necrosis in Poinsettia. There are a range of 'specialist' Poinsettia substrate mixes available to commercial growers. Controlled release fertilizers (CRFs) are not widely used in the commercial production of Poinsettias, but their slow release may have a beneficial effect on plant growth, particularly in shelf-life and home-life. As such, trials in 1994 evaluated the use of three specialist Poinsettia substrates with the use of CRFs in comparison to a standard liquid feed programme.

Crop scheduling is important in an attempt to produce high quality plants which are at a correct stage of maturity for marketing at Christmas. Both timing and method of pinching (manual or chemical) will clearly influence the growth and appearance of the final product. Previous research at both HRI Efford and HRI Littlehampton (HDC PC 71) has shown the wide varietal response in time of initiation for natural season (NS) production and the advantageous use of night break lighting (NBL) to delay crops. As part of this years trial the effect of pinching date on floral induction/initiation was examined, and whether early and late pinching affected the initiation response. Manual pinching is a labour intensive operation. *Dikegulac* (as Atrinal) is a chemical which is used successfully in the hardy ornamental sector to 'prune' some species, and has approval for use as a branching promoter in Begonias, *Azaleas* and Kalanchoes. Therefore, an initial observation was made to evaluate its potential for use as a pinching agent on Poinsettias.

All trials at Efford on Poinsettias include shelf-life assessments which are an integral part of the experimental treatments. Media type and nutrition were assessed in shelf-life. In addition, the way in which crops are handled in the marketing chain can have a major impact on their shelf-life, and final plant quality and longevity in the home. Thus, the use of sleeves and sleeving duration were studied to examine the effect on Poinsettia shelf-life. The effect of calcium sprays prior to marketing was also assessed as a control for bract edge necrosis.

2.2 OBJECTIVES

- To examine the effect of pinching date on floral induction.
- To evaluate the use of Atrinal as a chemical pinching agent as an alternative to manually pinching Poinsettias.
- To evaluate the effect of different substrate types on the growth and shelf-life of Poinsettias.
- To evaluate the use of controlled release fertilizers (CRFs) in the commercial production of Poinsettias and subsequently their effect on shelf-life.
- To evaluate the effect of sleeve duration on the shelf-life of Poinsettias.
- To examine the use of calcium sprays to reduce or prevent bract edge necrosis.

2.3 MATERIALS AND METHODS

A MAIN TRIAL HRI EFFORD

2.3.1 Site

Plants were grown in six compartments of the multifactorial glasshouse K-block at HRI Efford. Three of the compartments were benched with capillary matting whilst the other three compartments were flood floors (see layout in Figures 3 and 4, Appendix I, page 42).

Plants grown to evaluate the use of Atrinal as a pinching agent were grown in the single glasshouse, P-block (see layout in Figure 5, Appendix I, page 43).

2.3.2 Start Material

Three main cultivars were grown:

Red Sails	(Eckespoint)
Freedom	(Eckespoint)
Lilo	(Eckespoint)

All plants were supplied as rooted cuttings from Dümmen through Hollyacre Plants Ltd.

2.3.3 Treatments

Substrate: 3 types of specialist Poinsettia media were trialled:

A. ICI (UK)
B. Stender (Germany)
C. EGO (Netherlands)

Nutrition: A standard liquid feed programme was used in comparison to the use of controlled release fertilizer:

Osmocote Plus 5-6 months 15:10:12 + 2 Mg plus trace elements at 5 kg/m^3.

Pinching: A late pinch was compared to pinching early. All plants were pinched to 5-6 leaf nodes.

Early (soft) pinch - plants pinched 10 days after potting
Late (hard) pinch - plants pinched 18 days after potting

Use of a chemical pinching agent:

In a separate evaluation the use of *dikegulac* as Atrinal was compared against a standard manual pinching method.

Rates of Atrinal used applied 10 days after potting:

i. 10 ml/l
ii. 20 ml/l
iii. 30 ml/l

All plants were sprayed until run-off, and plants were subsequently shaded using woven fleece for 7-10 days.

Shelf-life:

Plants of each cultivar from each of the media x nutrition treatments were evaluated in shelf-life, along with two further sub-treatments:

Calcium sprays to prevent bract edge necrosis

i. plants sprayed at 50% colour with 400 ppm calcium chloride
ii. control - plants were sprayed with plain water only

Sleeve duration

Using micro perforated polythene sleeves;

i. plants remained sleeved for 5 days in shelf-life.
ii. plants remained sleeved for 10 days in shelf-life.

Shelf-life Schedule:

Plants were sleeved and boxed (6 plants per box in a tray) and had a market run of 100 miles.

On return, plants entered cool store with conditions:

15°C
RH approx 80%
No lighting

After four days in cool store plants entered shelf-life with an environment;

18-20°C day/night
RH approx 50-60%
Light level at plant canopy of 1000 lux, 0600 hrs until 1800 hrs, provided by cool white fluorescent tubes.

Plants were spaced as close as possible whilst in sleeves and watered from below onto capillary matting after unpacking and then as required.

After 5 or 10 days plants were unsleeved.

Plants were spaced to approximately 8 m^2. Watering was as required by hand from below into each individual drip tray. Plants were checked daily.

2.3.4 Experimental Design

Unreplicated split plot design. The substrate component was at the compartment level with each substrate evaluated on both benches (capillary matting) and ebb and flood floors.

Pinching was at the sub-plot level with the three cultivars as sub sub plots.

6 main plots (substrate/nutrition)
x
2 sub plots (pinching)
x
3 sub sub plots (cultivars)
---
36 plots (60 plants/plot - pot thick)

Each of the 36 sub-plots was further subdivided into +/- calcium chloride sprays. From the resultant 72 plots a total of six plants per plot were subjected to shelf-life assessment; 3 plants remaining sleeved for 5 days and the balance for 10 days.

2.3.5 Cultural Details

All plants were potted in 13C terracotta pots using each of the substrate treatments. Plants grown to evaluate the effect of pinching date on floral initiation, and the use of Atrinal as a chemical pinching agent were grown in Levington M2 compost, again using 13C terracotta pots.

Temperature:

Plants were grown at minimum heating set point of 20°C day/night for the first 4 weeks after potting, at which point the minimum heating set point was reduced to 18°C and venting to 20°C. Near to marketing, the minimum heating and venting set point were reduced in 1°C steps to 16°C day/night heating and vent at 17°C.

Lighting:

Use of night break lighting (NBL) was used on all plants from 10 September until 2 October (10 days delay). Lights were on from 2230 hrs until 0230 hrs each night. NBL lighting was provided by 60W tungsten filament bulbs held 2m over the crop canopy to achieve minimum light level of 500 lux.

Blackout:

Applied to all glasshouse compartments from 10 September until 2 October, from 1800 hrs until 0600 hrs each night.

Pinching:

Plants were pinched to 5-6 leaf nodes. Plants were covered with fleece for 7 days after pinching to maintain a constant humidity immediately around each plant and aid plant breaking.

Carbon Dioxide: There was no carbon dioxide enrichment.

Humidity Control:

There was no direct humidity control other than the use of woven fleece for 7 days after pinching to maintain a relatively constant humidity around the plants, and subsequently compartment benches and floors were regularly damped down during August and September to maintain relatively high humidities.

Irrigation:

Where plants were grown on capillary benches, watering was by hand direct onto the capillary matting. Ebb and flood floors were sub-irrigated automatically.

Nutrition: Standard ADAS liquid feed programme was used.

Initial feed commenced once breaks were first visible (1-2 cm length):

Stock Feed	Grammes/litre
Mono-Ammonium Phosphate	20
Potassium Nitrate	66
Ammonium Nitrate	113
Ammonium Molybdebate	0.05
Librel Fe lo	0.2

250N:60P:150K plus 0.1 mg/l Mo - at every watering.

Final feed commenced at first colour.

Stock Feed	Grammes/litre
Mono-Ammonium Phosphate	17
Potassium Nitrate	87
Ammonium Nitrate	76
Ammonium Molybdebate	0.05
Librel Fe lo	0.2

200N:50P:200K plus 0.1 mg/l Mo - feed at every watering.

Controlled release fertilizer: 5-6 month Osmocote Plus
15:10:12 + 2 Mg + traces at the rate 5 kg/m^3

Plant spacing:

Plants remained pot thick for approximately 5 weeks, once the breaks had properly developed, at which point plants were given an intermediate spacing of 34/m^2. Plants were final spaced after 9½ weeks to 11/m^2.

Plant growth regulation:

Chlormequat as Cycocel (46% a.i) was used to regulate plant height. Records of applications are given in the crop diary, Appendix II, page 44.

Pest and Disease Control:

An Integrated Pest Management programme was employed throughout the duration of the trial (see Crop Diary in Appendix II, page 44 for details).

2.3.6 Assessments

The following assessments were made throughout the trial.

- date of 50% colour per plot (treatment)

Plant Growth Measurements at Marketing

- plant height
- plant diameter
- number of bracts and their size
- quality score (0-2, 2 = best)

Growing Media and Leaf Tissue Analysis

- growing media samples were taken at potting and at intervals during production and shelf-life
- leaf tissue samples were taken at marketing from each cultiver to examine calcium content

Shelf-life Records

- leaf drop/leaf yellowing
- cyathia loss
- bract necrosis
- mechanical damage/bract deterioration
- potting media analysis

2.3.7 Statistical Analysis

Due to the absence of full replicates within this experiment the resultant data were not subjected to formal statistical analysis.

2.4 B SUBSIDIARY TRIAL HRI EFFORD AND LITTLEHAMPTON

2.4.1 Site

The subsidiary trial evaluated a range of novel cultivars alongside those used in the main trial (controls). The cultivars evaluated occupied two compartments of K-block being grown both as natural season (NS) and delayed (10 days NBL) crops. These cultivars provided material for detailed initiation assessments by Dr Allen Langton (HRI-Littlehampton). The date of pinching would potentially influence the date of NS initiation by influencing the size of the breaks at the start of inductive conditions.

2.4.2 Start Material

In addition to the three main cultivars assessed in the main trial at Efford, Red Sails, Freedom and Lilo, a further three cultivars were examined:

Menorca	(Dümmen)
Ria	(Gross)
Marlene	(Dümmen)

All plants were supplied as rooted cuttings through Hollyacre Plants Ltd.

2.4.3 Pinching treatments

Subsidiary Trial: 2 compartments of K-block, K6 (NS) and K9 (NBL)

i. NS induction, pinching 23 days before equinox - 3 weeks after potting

ii. NBL induction, pinching 23 days before 2 October - 5 weeks after potting

iii. (Control) NBL induction (Main Trial)
1 - pinch 41 days before 2 October - 10 days after potting
2 - pinch 33 days before 2 October - 18 days after potting

Cultivars: Red Sails, Freedom and Lilo = pinching treatments i), ii) and iii)
Ria, Marlene and Menorca = pinching treatments i) and ii) <u>only</u>

2.4.4 Cultural Details

All plants were potted in 13C terracotta pots using Levington M2 growing media.

Lighting:

Use of night break lighting as appropriate from 10 September until 2 October (10 days delay). Lights were on from 2230 hrs until 0230 hrs each night. NBL lighting was provided by 60W tungsten filament bulbs held 2m over the crop canopy to achieve minimum light levels of 500 lux.

Blackout:

Was applied to NBL glasshouse compartment from 22 September until 2 October, from 1800 hrs until 0600 hrs, to ensure no light spill from the NBL treatment.

All other cultural details are as per those stated in the Main Trial - HRI Efford.

2.4.5 Assessments

Samples for dissection:

NS	6 cvs x 4 sample dates	=	24	5-plant samples
NBL	6 cvs x 3 sample dates	=	18	5-plant samples
NBL (control)	3 cvs x 3 sample dates	=	9	5-plant samples

Total = 51 samples

Dates of sampling:

		Treatments		
Week No.	Date	i	ii	iii
39	26.09	✓	-	-
40	03.10	✓	-	-
41	10.10	✓	-	-
42	17.10	✓	✓	✓
43	24.01	-	✓	✓
44	31.10	-	✓	✓

Plants were selected at random and the penultimate shoot was used on each plant for the initiation studies. Using a binocular microscope, the growing tip of the shoot was carefully dissected to reveal the apical meristem. Upon examination each tip was attributed a score, 1-6, to determine the stage of floral induction, 6 being a plant fully initiated (see Appendix III, page 45 for details of scoring system used).

2.5 C COMMERCIAL TRIALS

2.5.1 Trial One

Objective: To assess the effect of early and late pinching on Poinsettia growth.

Site: Helmut Gimmler Ltd
New Milton
Hampshire

Cultivar:

Red Sails, (Eckespoint). Supplied as rooted cuttings from Hollyacre Plants Limited.

Treatments:

Pinched 'a' 7 days after potting on 26 August.
Pinched 'b' 14 days after potting on 2 September.

Cultural Details:

Potted 17 August 1994 (Week 31).
Grown as a 13 cm commercial crop using ICI Poinsettia potting media.
Temperatures as a commercial crop with use of DIF and plant growth regulator *Chlormequat* as Cycocel to provide plants to a commercial specification.

Records:

a. Cutting size - No. shoots after pinching, 26 September.
b. Plant height, diameter, bract and shoot number, 25 November.

2.5.2 Trial Two

Objective:

To assess a range of new Poinsettia cultivars for commercial production in the UK.

Site: Helmut Gimmler Ltd
New Milton
Hampshire

Cultivars:

***Fischer* cultivars**	**Colour**
Bonita	Red
Cortez	Red
Flirt	Pink
Noblestar	Dark Salmon
Picacho	Red
Puebla	Pink Cream edge
Puebla (Dark)	Dark Pink Cream edge
Sonora	Red

Cultural Details:

Potted 17 August 1994 (Week 31), pinched 26 August (Week 32).
Grown as a 13 cm commercial crop amongst main plantings, and thus plants were treated with same Cycocel rates, applications, etc.

Records:

a. Cutting size of pinched plant and no. shoots, 26 September.
b. Plant height, diameter, bract and shoot number, 25 November.

3A. RESULTS - MAIN TRIAL EFFORD

3.1 Marketing Dates

There was no effect of cultural treatments on the time of marketing. The cultivar Freedom was quickest to reach marketing, 29 November, whilst the cultivars Lilo and Red Sails were recorded on 6 December and 13 December respectively.

3.2 Assessments at Marketing

3.2.1. Plant Height

Throughout the trial *Chlormequat* as Cycocel was used to control plant height giving a final plant height specification of 26-30 cm above the height of the pot. Records of Cycocel applications are given in the Crop Diary, Appendix II, page 44. As such the heights recorded at marketing vary very little between the cultural treatments. However, during the trial, plants grown in substrate amended with CRF's appeared more compact and required a closer spacing in the later stages of growth to ensure that the minimum height specification of 26 cm was met. Media type B, Stender, with inclusion of CRF failed to meet the minimum height requirement. The cultivar Red Sails was slightly taller than either Freedom or Lilo (Table 9, Appendix IV, page 46).

3.2.2 Plant Spread

Mean plant spread was affected in a similar manner to plant height. The use of CRF's tended to reduce overall plant size, particularly in use with Stender media (Table 10, Appendix IV, page 46). Plant spread appeared to be more a factor of plant spacing rather than treatment effect, although higher nutrient levels in the growing media resulted in reduced plant vigour and overall size.

3.2.3 Number of Breaks

There was no effect of cultural treatment on the breaking action of plants. All plants had on average 5-6 breaks and the choice of cultivar had more of an effect. Freedom had a greater number of breaks, 6.04 per plant, whereas Red Sails had 5.6 breaks and Lilo 5.5 breaks per plant (Table 11, Appendix IV, page 46).

3.2.4 Number of Bracts and their Size

There was no effect of media treatments on the number of bracts. Bract size was reduced in media treatments with CRFs, with a greater number of bracts in the lower size categories (Tables 12-14, Appendix IV, page 47). Freedom had consistently larger bracts than either Red Sails or Lilo.

3.2.5 Plant Quality

Although plants were small, their quality was generally good. The cultivar Red Sails was on average, of higher quality than either Freedom or Lilo. There were no consistent differences between media types but the use CRF's tended to produce smaller, 'harder' looking plants which were down graded at marketing (with the exception of media type C, EGO) and had lower quality scores (Table 15, Appendix IV, page 48).

3.2.6 Plant Unevenness

At marketing an assessment was made on the number of plants which were uneven in their habit/growth.

The cultivars Red Sails and Lilo had a considerably higher number of plants which were uneven, whilst Freedom was relatively uniform in its habit. There were no consistent differences between the cultural treatments (Table 16, Appendix IV, page 48).

3.3 Growing Media and Leaf Tissue Analyses

Results of media analyses at potting and from samples taken during the trial are given in Tables 17 to 21, Appendix VI on pages 50 to 54. In addition, weekly conductivity readings were taken using an AM PET 2000 meter. The results are shown graphically in Figures 6 and 7, Appendix VII, page 55. Details of the AM PET 2000 and its instructions for use are given in Appendix VIII, pages 56 to 58. Leaf tissue analysis results are given in Tables 22-25, Appendix IX, pages 59 and 60

3.3.1 Media Analysis at Potting

The composition of each media type is given in Appendix V, page 49. Media types A and C, ICI and EGO respectively, were very similar in their composition, both included perlite and had similar nutrient levels at potting. Stender was quite different, with both the addition of 10% clay granules and 20% coconut fibre (coir). The nutrient levels in this substrate were much higher in comparison to either the ICI or EGO and additional iron had been included. Media analysis for each substrate is given in Table 17, Appendix VI, page 50. pH levels in ICI and EGO were 5.6 and 5.5 respectively whilst Stender had a much higher starting pH of 6.6. In addition to

Stender's generally higher nutrient starter it had higher levels of ammonium N in comparison to the two other mixes.

3.3.2 Media Analysis during Production

Samples were taken from all media treatments on 12 October (mid crop) and on 3, 13 and 19 December 1994 (marketing). Colour plates 1 and 2, Appendix XIV on pages 76 and 77 show treatment comparisons of plant growth and rooting as on 4 October 1994.

Media analysis on 12 October (Table 18, Appendix VI, page 51) showed increased conductivity levels in media type B (Stender) and in all substrates with CRF. The pH of Stender had dropped from 6.6 at potting down to 5.8 (and 4.7 with inclusion of CRF). This may be attributed to the higher initial ammonical-nitrogen at potting which would potentially lower the pH of the substrate. The level of nutrients in Stender with CRF was considerably higher than the other media treatments. The ICI and EGO mixes were very similar in their analysis. Media analysis during December at marketing showed that Stender continued to have a higher nutrient status, particularly with the inclusion of CRF. In both ICI and EGO levels of nutrients were very similar, and in the treatments with CRFs the nutrient levels were reduced in comparison to the standard liquid feed treatments (Tables 19-21, Appendix VI, pages 52 to 54).

The results of the AM PET 2000 meter recording nutrient activity levels each week from potting showed the differences between the media types and nutritional regime (Figures 6 and 7, Appendix VII, page 55). The nutrient activity readings from Stender were consistently higher than those of either ICI or EGO. These two mixes were very similar in their nutrient activities. The use of CRFs produced a relatively consistent level of nutrient activity throughout the cropping period, whilst those readings taken from each media type using a liquid feed programme varied much more. At potting the readings were 'moderate' but reduced quickly coinciding with the most rapid period of plant growth. Levels of nutrients rose rapidly in week 43 (last week October).

3.3.3 Leaf Tissue Analyses

Samples of leaf tissue were taken on 26 October (mid-crop) and at marketing for each cultivar (Tables 22-25, Appendix IX, pages 59 and 60).

Analysis of samples on 26 October revealed higher levels of calcium from plants grown in Stender, whilst levels of magnesium and manganese were lower (with the exception of Red Sails where there was no difference in manganese levels between treatments). Typically, the use of CRFs tended to reduce potassium levels whilst calcium and manganese levels were higher. Nitrogen and phosphorous levels were similar between liquid feed and CRF fed plants. In all samples, no deficiency levels were recorded.

Further leaf tissue samples were taken at marketing for each cultivar, specifically to observe the levels of calcium in the leaves from plants treated with calcium sprays in comparison to untreated plants. Across all cultivars there were no consistent differences in calcium between treated and non-treated plants; typical levels recorded were between 0.3 and 0.4%, with higher levels in Red Sails in comparison to either Freedom or Lilo.

There were no apparent differences in levels between media or nutritional treatments, although commonly the levels of manganese were higher in plants grown with CRF. In comparison to the earlier leaf tissue samples, with the exception of potassium, all other mineral levels were lower in comparison to those recorded in October.

3.4 Shelf-life Assessments

Records of plant quality and deterioration in shelf-life are given in Appendix X, pages 61 to 67. Colour plates 3 and 4 in Appendix XIV, pages 78 and 79 show plants from each media type, with or without the use of CRF's at the end of shelf-life.

3.4.1 Effect of Media Type and Nutrient Regime (Figures 8-10, Appendix X, pages 61 to 63)

With the exception of media type A, ICI, in which there was greater leaf drop and yellowing of Red Sails, there were no consistent differences between cultural treatments on the shelf-life of each cultivar. It appeared that leaf drop and yellowing in Lilo was reduced where plants had been grown with CRFs, but the differences were very small. In general, plants appeared of good quality throughout the shelf-life assessments, and colour plates 3 and 4 in Appendix XIV, pages 78 and 79 show plants at the end of 4 weeks in shelf-life.

3.4.2 Effect of Calcium Sprays on Bract Necrosis

Levels of bract necrosis recorded in shelf-life were very low. Nevertheless, plants of Freedom and Red Sails which had been sprayed with calcium chloride at first colour had slightly less bract necrosis. The level of bract necrosis in Lilo was unaffected by the use of calcium sprays (Figure 11, Appendix X, page 64).

3.4.3 Effect of Sleeve Duration on Shelf-life

Figures 12, 13 and 14 in Appendix X, pages 65 to 67 show the results in shelf-life of plants sleeved for either 5 or 10 days. There was little effect of sleeve duration on bract deterioration in each of the cultivars. Lilo was recorded to have a slightly higher incidence of bract deterioration at 10 days sleeving and in subsequent assessments.

Leaf drop and yellowing was higher in the cultivar Red Sails, and to a lesser extent Lilo, which had been sleeved for 10 days. There was no effect of sleeve duration on leaf drop or yellowing on Freedom.

Lilo and Red Sails suffered more rapid cyathia loss where plants were sleeved for 10 days in comparison to plants sleeved for only 5 days. There was no effect on cyathia drop for the cultivar Freedom.

3.4.4 Media Analysis in Shelf-life

Samples of growing media were analysed in shelf-life on 18 January and 3 February 1995. In addition, analysis of the CRF granules was done on 3 February to establish the amount of nutrients which remained in the granules and available to the plant (Tables 26-28, Appendix XI, pages 68 to 70).

The analysis results give an indication of the nutrient availability to plants during shelf-life and in the 'home'. During shelf-life, when plants were irrigated with plain water only, there was a general reduction in the level of nutrients available, with the exception of the media type Stender, which consistently had a higher level of nutrients, particularly with the inclusion of CRFs. The pH of the media also rose during shelf-life as a result of the applied water with a pH near to 7.5 (mains water).

3.5 Effect of pinching date on total number of breaks

There was no considerable difference between the number of breaks on plants pinched early in comparison to those pinched late (Table 1).

Table 1 **Effect of pinching date on total number of breaks**

	Treatment	
	Early (soft) pinch	**Late (hard) pinch**
Red Sails	5.7	5.6
Freedom	6.3	5.8
Lilo	5.6	5.5
Mean	5.8	5.6

3.6 Use of chemical pinching agent Atrinal

Colour plates 5A and 5B in Appendix XIV, page 80 show clearly the effect of Atrinal on plant growth.

From the three rates used 15 ml/l, 20 ml/l and 30 ml/l, 20 ml/l appeared to inhibit the main shoot without causing permanent damage either to the leaves or side shoots on the main stem. At 15 ml/l, the main shoot continued to extend, whilst severe leaf scorch occurred at the rate of 30 ml/l.

At the rate of 20 ml/l apical dominance was removed and the sideshoots on the main stem broke away well. The effect of spray applications was to cause a severe reduction in plant growth. The number of breaks was considerably higher for treated plants in comparison to manual pinching. However, as a consequence of its use, plant growth was much slower in the early stages and plant size was reduced at marketing.

B SUBSIDIARY TRIAL - HRI EFFORD AND LITTLEHAMPTON

3.7 Dissection Studies - Littlehampton

Figure 1 (below) shows the progression of early flower development under natural season conditions, with sample dates of 26 September, 3 October, 10 October and 17 October. Plants sampled on 24 October were all off the scale. Lilo was ahead of the other cultivars, closely followed by Freedom. The other cultivars were slower but rather similar.

Figure 1 Natural season induction 1994

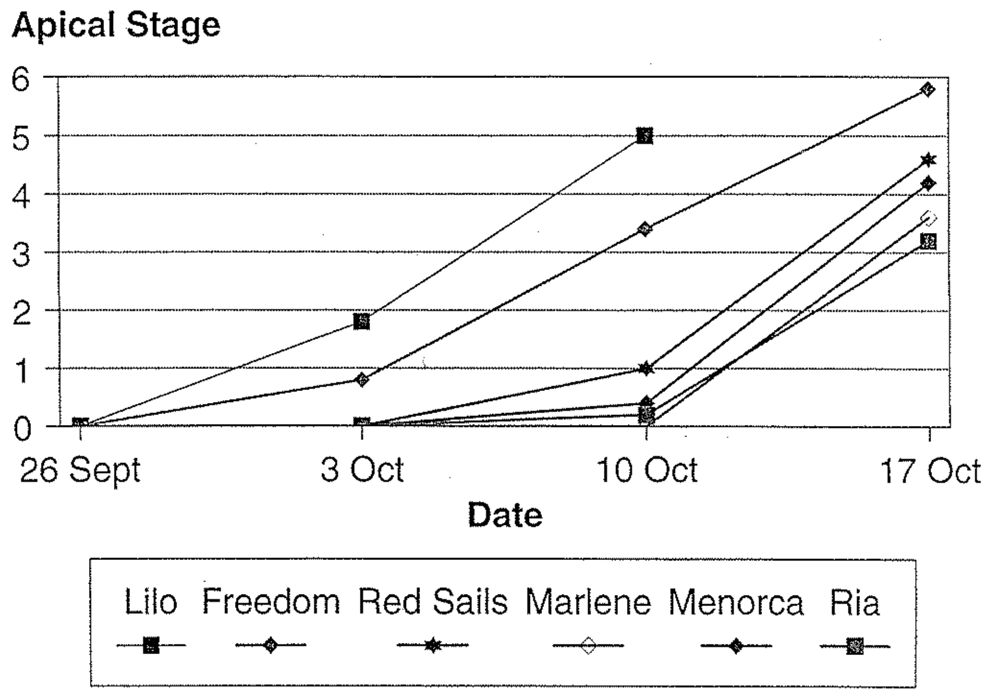


Figure 2 shows the early flowering data for NBL plants pinched the same number of days prior to 2 October as NS plants before the equinox, 22 September. Therefore, sideshoots were at a similar physiological maturity when inductive conditions were experienced in both NBL and NS crops. Lilo and Freedom were ahead of the other cultivars even though all cultivars started flower induction process at the same time.

Figure 2 **Night Break Lighting Induction 1994**

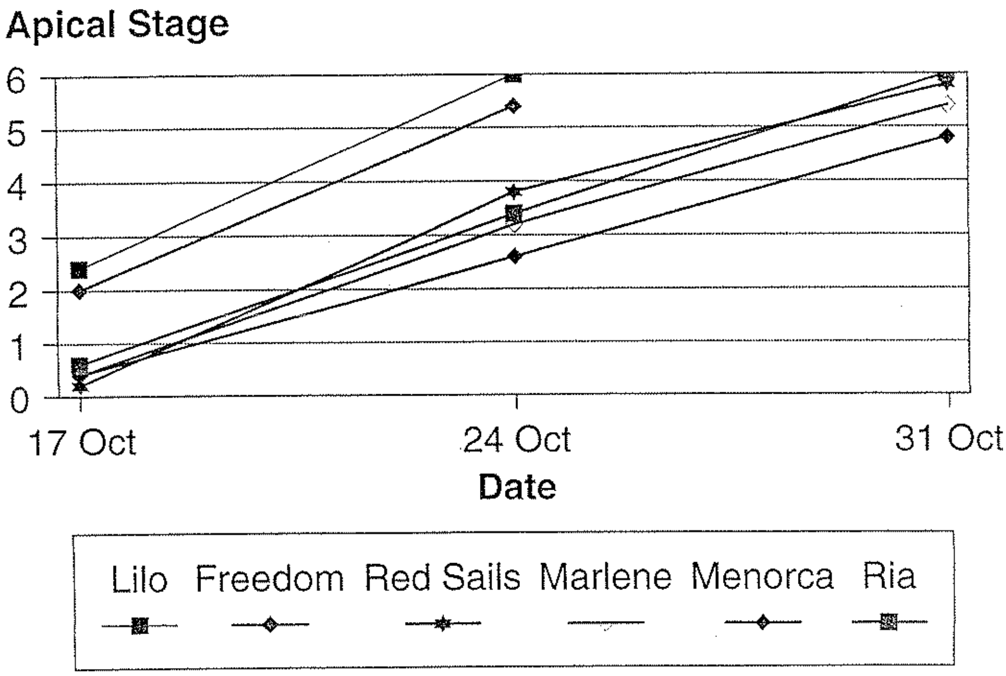


Table 1 summarises the dates when NS and NBL plants reached apical stages 2 and 3, and provides an estimate for NS flower induction by substracting NBL days from NS stage dates. Lilo initiated first, 19/20 September, closely followed by Freedom, 21/22 September with the rest following behind; Ria being the longest at 25/26 September.

Table 1 **Summary of NS and NBL dates for apical stages 2 and 3, and an estimated NS induction date**

	N/S date - stage 2	N/S date - stage 3	NBL - days to stage 2	NBL - days to stage 3	Estimated N/S induction date
Lilo	3/4 Oct	6 Oct	14/15	16	19/20 Sept
Freedom	6 Oct	9 Oct	15	17	21/22 Sept
Red Sails	12 Oct	14 Oct	18	20	24 Sept
Marlene	14 Oct	16 Oct	19	21/22	24/25 Sept
Menorca	13 Oct	15 Oct	20	23	22/23 Sept
Ria	14 Oct	16/17 Oct	18	21	25/26 Sept

Table 2 shows the estimates of flower induction dates obtained over the past three years. Five of the cultivars were assessed in both 1993 and 1994, and in all cases they appeared to have 'initiated later' in 1994.

Table 2 Flower induction dates 1992/4

	1992	1993	1994
Alstar	21-24 Sept	-	-
Angelika	24-26 Sept	-	-
Fireking	-	21-22 Sept	-
Francesca	-	22-23 Sept	-
Freedom	-	17-19 Sept	21-22 Sept
Glenda	-	20-22 Sept	-
Goldfinger	22-24 Sept	-	-
Lilo	17 Sept	15-19 Sept	19-20 Sept
Marlene	-	-	24-25 Sept
Menorca	-	18-21 Sept	22-23 Sept
Peterstar	21 Sept	-	-
Ria	-	18-20 Sept	25-26 Sept
Red Sails	24 Sept	16-19 Sept	24 Sept
Steffi	21 Sept	-	-

Table 3 shows the number of days to apical stage 2 and 3 for early pinched and late pinched plants. Plants pinched early showed slower flower development.

Table 3 Number of days to apical stage 2 and 3 for early and late-pinched plants

	Days to stage 2 - early pinch	Days to stage 2 - late pinch	Days to stage 3 - early pinch	Days to stage 3 - late pinch
Lilo	16-17	14-15	18	16
Freedom	16	15	19	17
Red Sails	24	18	26	20

Table 4 shows leaf numbers for the shoots dissected. The early-pinched NBL plants had more leaves than the NS plants (pinched at the same time), showing the influence of the extended growth phase under photoperiodic lighting. The early-pinched NBL plants had more leaves than the late-pinched NBL, as would be expected. The late pinched NBL plants had more leaves than the NS plants, pinched at the same time before induction. This is attributable to NBL receiving higher temperatures for a short period to boost plant growth.

Table 4 Leaf numbers for NBL and NS plants of each cultivar

	LILO	FREEDOM	RED SAILS	MARLENE	MENORCA	RIA
Natural Season	15.1	12.9	15.4	15.1	16.9	13.9
NBL - early pinch	20.2	15.6	19.6	-	-	-
NBL - late pinch	17.4	14.9	16.0	15.9	17.6	14.9

3.8 Rate of Bract Colour Development

Dates to 50% colour for natural season plants and those delayed by NBL for 10 days are given in Table 29, Appendix XII, page 71. Freedom was quite clearly the quickest cultivar to colour up whilst Menorca was the slowest. The use of NBL delayed colouring by on average 12 days. Colour plates 6 and 7 in Appendix XIV, pages 81 and 82, show the comparison between NS and NBL grown plants for each cultivar.

3.9 Plant Growth Assessments at Marketing

3.9.1 Plant height

Plant height was increased by the use of NBL (Table 30, Appendix XII, page 72).

3.9.2 Plant Spread

Mean plant spread was greater where plants had been grown with the use of NBL (Table 31, Appendix XII, page 72).

3.9.3 Number of Bracts and their Size

Lilo had considerably less bracts in comparison to the other cultivars; 5.6, in contrast to Menorca which had on average 6.7.

Bract size was influenced by cultivar and the use of NBL. The cultivars Freedom and Red Sails had generally a greater number of larger bracts, whilst Menorca had consistently smaller bracts (Table 32, Appendix XII, page 73).

C RESULTS - COMMERCIAL TRIALS

3.10 Trial One - Effect of pinching date on plant growth of cv Red Sails

3.10.1 Assessments of Cuttings after Pinching

Plants which were pinched later, 14 days after potting, had an increased cutting size whilst shoot size was reduced (Table 5).

Table 5 Cutting size and number of shoots; 26 September

Treatment	Height of stopped cutting (cm)	Height to top shoot (cm)	No Shoots
7 day pinch (18 Aug)	4.8	14.3	5.5
14 day pinch (2 Sept)	7.1	10.7	7.0
Mean	6.0	12.5	6.3

3.10.2 Plant Growth Assessments at Marketing

At marketing, the plants pinched 7 days after potting appeared to be slightly larger in size. Plant height and plant spread were greater, and the number of shoots (breaks) and bracts was increased. Bract size was also increased (Table 6).

Table 6 Plant growth assessments at marketing; 25 November

Treatment	Height (cm)	Plant spread (cm)	No. Shoots	No. Bracts	Diameter of bracts (cm)
7 day pinch	25.9	46.5	6.7	6.6	28.6
14 day pinch	23.3	43.3	6.4	5.3	25.2
Mean	24.6	44.9	6.6	6.0	26.9

During the 1994 season, growers recorded an above average number of plants which were poor in breaking and subsequently graded with less than 4 breaks per plant. Plants supplied and potted in week 31 and subsequently pinched had up to 45% of plants with less than 4 shoots developing. In later pottings the incidence was less; 25% of plants from week 32 potting.

Previous research work has shown that stock plants grown at temperatures over 32° C will produce cuttings which have a reduced 'breaking action'. It is thought that plant growth at such high temperatures causes the growing shoots to outgrow the *factor* responsible for breaking (as is the technique used to clean plants of viruses). During the period July/August 1994 it was not uncommon for temperatures under glass to reach 35° C, and this potentially caused cuttings taken at this time to produce fewer than expected shoots. This problem is worse on dark leaved cultivars; Red Sails and Lilo.

3.10.3 Shelf-life Assessments

Plants were despatched to HRI Efford to undergo shelf-life assessments in the controlled environment rooms. Plants from each pinching treatment were sleeved for either 5 or 10 days in shelf-life (same period/treatment as used in the main trial at Efford).

Results of shelf-life are given in Figure 15, Appendix XIII, page 74. There were no consistent differences between either pinching treatments or sleeve duration on the shelf-life of Red Sails.

3.11 TRIAL TWO - VARIETY TRIAL 1994

Eight new cultivars were trialled on a commercial nursery.

3.11.1 Assessments of Cuttings after Pinching

All plants were pinched to 7 leaves. Bonita had a comparatively small cutting, with the pinch made at 3.8 cm, whereas Puebla was pinched at 5.9 cm. With the exception of Cortez and Sonora, all the cultivars broke freely with at least 6 good shoots per plant (Table 7 overleaf).

Table 7 Cutting size and number of shoots; 26 September

Cultivar	Height of cutting at stopping (cm)	Height to top shoot (cm)	No Shoots
Bonita	3.8	9.6	6.4
Cortez	4.7	9.0	4.6
Flirt	4.7	10.3	5.8
Noblestar	4.4	10.2	6.7
Picacho	4.4	9.7	6.2
Puebla	5.9	11.3	6.3
Puebla (Dark)	5.2	10.5	6.2
Sonora	5.4	10.4	5.3
Mean	4.8	10.1	6.0

3.11.2 Plant Growth Assessment at Marketing

At marketing, all of the cultivars failed to meet the necessary height specification of 26-30 cm. Bonita and Puebla were slightly taller than the other cultivars, but generally all the cultivars were more compact in their habit. Plant spread was generally uniform across the cultivars, with the exception of Cortez which had a much broader habit. Bonita had a greater number of bracts whilst Cortez, Flirt and Puebla had fewer; 4 bracts per plant.

Bract size varied with cultivar. Cortez had larger bracts, commencing 29 cm, whilst Puebla had much smaller bracts, 22 cm (Table 8).

Table 8 Plant growth measurements at marketing; 25 November

Cultivar	Height (cm)	Diameter (cm)	No. Shoots	No. Bracts	Diameter of bracts (cm)
Bonita	21.3	41.6	6.2	5.3	26.2
Cortez	16.0	45.4	4.8	4.0	29.5
Flirt	18.5	42.3	5.6	3.9	27.8
Noblestar	17.9	40.8	6.2	4.6	27.5
Picacho	16.2	39.0	6.1	4.8	24.7
Puebla	21.9	41.0	6.7	4.0	22.4
Puebla (Dark)	19.5	42.6	7.6	4.6	27.4
Sonora	18.9	37.6	5.4	4.5	25.4
Mean	18.8	41.3	6.1	4.5	26.4

Plants had been grown on a commercial nursery alongside a commercial crop. Consequently the trial cultivars received the same cultural practices as commercial plants which at one point included a period of lower growing temperature which may have reduced the final plant height.

3.11.3 Shelf-life Assessments

Results of the shelf-life assessments for each cultivar are given in Figure 16, Appendix XIII, page 75.

The cultivars Bonita, Noblestar, D. Puebla and Picacho suffered rapidly from bract deterioration. Cortez had less rapid bract deterioration whilst the cutivars Flirt, Sonora and Puebla were in comparison the best.

The cultivars D. Puebla, Noblestar and Bonita also suffered badly with greater leaf drop and yellowing. All cultivars lost many leaves throughout the duration of the assessments. Sonora and Flirt lost less leaves than the other cultivars.

There was a trend between cultivars in terms of cyathia loss in shelf-life. The cultivars Puebla, Sonora and Flirt held their cyathia better in comparison to all the other cultivars.

3.11.4 Varietal Characteristics

Comments made at marketing for each cultivar are given below.

Bonita

Pale Red, lighter in colour than Picacho, bracts larger than Picacho. Large number of cyathia but small. *Botrytis* evident on lower leaves and beginning to spread up the plant.

Cortez

'Velvet' Red, very bright colour, bracts fully cover the mid-green foliage. Cyathia small, 6/8 per bract, some abscision evident.

Flirt

Pink bracts. Cyathia good, 14/16 per bract. Large leaf size, some variation within the cultivar.

Noblestar

Dark salmon pink bracts - novel colour. Medium green leaf, cyathia large, average 10 per bract.

Picacho

Bright pillar box red, puckered bract with spiky appearance. Cyathia good, 12 per bract, darker leaf colour.

Sonora

Bright red bract, cyathia variable in size, 4/8 per bract. Suitable for 10 cm pot, or potting earlier for 13 cm.

Puebla

Strongly marbled appearance - pink with cream edge. Late to mature. Mid-green leaf.

Dark Puebla

Similar to Puebla but with deeper pink and greater cream edge.

4. DISCUSSION

The effect of different cultural practices, specifically media type and nutrition, on the production and shelf-life of Poinsettias has previously received little attention in the UK. Therefore, it was the aim of these trials to examine the use of three specialist Poinsettia substrates, and the use of controlled release fertilisers in comparison to a more common approach of regular liquid feeding. In addition, the effect of the timing of pinching and the method used (manual or chemical) was also evaluated. The trial also included plant dissections to examine the effect of pinching date on floral initiation and development.

The three specialist media types used were ICI (UK), Stender (German) and EGO (Netherlands). Both the ICI and EGO mixes were very similar in their composition and nutrient status at potting, whilst Stender mix appeared quite different and included a percentage of coir and additional chelated iron. The nutrient status of this substrate at potting was much higher in comparison to the other two mixes. During production the growth of the plants became typically more compact, 'harder', in the media types with elevated nutrient levels, specifically Stender and all three mixes with CRFs included. Consequently it was necessary in the later stages of growth to manually space plants closer together in the attempt to increase plant height, otherwise plants would have remained very compact and would not have reached the minimum height specification at marketing. Generally, it was felt that the inclusion of CRFs prevented any manipulation of the nutrient regime and subsequently of plant growth. However, within the context of this trial, a longer term CRF was used at the highest recommended rate, 5 kg/m^3 and there may be potential to use a reduced rate of CRF. The results from this trial do suggest that it is unadvisable to use high rates of CRF in complete replacement of liquid feeds. However, the evaluation of CRF has been done under only one set of environmental conditions, as experienced during the 1994 season, and further work will be necessary to evaluate fully the use of CRFs in Poinsettia production. A number of commercial growers do successfully use CRFs in their production of Poinsettias. Their use is often at lower rates than adopted in this trial and used in conjunction with a liquid feed programme to supplement the CRF.

The use of each of these specialist media types successfully produced marketable plants. It would be necessary to tailor the irrigation requirements for each media type. The Stender mix was very different in its irrigation needs compared to either the ICI or EGO mixes. Stender had a much higher water holding capacity, probably due to its coir component, and subsequently needed less frequent irrigations. Its higher nutrient status at potting appeared to slow plant growth in the early stages of production and this was exaggerated with the use of CRF in the substrate mix. The ICI and EGO mixes were very similar in their characteristics, both with the inclusion of perlite, and this appeared to increase root vigour, although no quantative measurements were taken as part of this trial. The standard liquid feed programme adopted for the trial appeared to suit both these media mixes, and regular irrigations were maintained in contrast to the Stender mix, which with its higher water holding capacity could not be irrigated/fed as regularly. In general, the specialist media mixes used in the trial performed very well. The difference between the substrates, specifically in relation to the Stender mix, and both the ICI and EGO demonstrate the potentially wide variation in media types available, and the need for careful consideration in their choice for each system of production. Management of irrigation and nutrition will be vital to ensure that the performance of each substrate is optimised. The choice of growing system available on the nursery may affect the final choice of a growing medium, e.g. flood irrigation or capillary matting. The use of capillary matting can be advantageous with the use of high water holding capacity substrates, in which continually high moisture levels may cause rooting problems. The capillary matting can have the ability to 'draw' water from the substrate and increase the air porosity.

In shelf-life there was very little plant deterioration and there were no obvious differences recorded between media type or nutrient regime treatments. All the plants remained of good quality throughout shelf-life assessments. The shelf-life records were terminated at the end of 4 weeks, however, subsequent observations tended to show that plants grown in a substrate which included CRFs appeared to 're-grow' more rapidly, particularly on the cultivar Red Sails. Re-growth was characterised by the production of new leaves/bracts at the head of the plant. This may or may not be seen as an advantage, but demonstrated the vigour of these plants.

As the levels of bract necrosis were minimal in this years trial, no firm conclusions can be drawn on the use of calcium sprays to prevent bract necrosis. There was slightly less bract necrosis on both Lilo and Freedom which had been sprayed with calcium chloride. In general, plant nutrition was good and leaf tissue analysis failed to show any difference in calcium or potassium levels in plants which had been/had not been sprayed with calcium chloride. Further research conducted in the United States has tended to focus more on potassium levels rather than purely calcium, and research is continuing to examine the casual factor of bract necrosis. In the UK, the incidence of bract necrosis in 1994 was reportedly very low, and maybe in part due to the greater use of calcium nitrate as the nitrogen source in liquid feeds which would boost calcium levels.

Sleeve duration in shelf-life did affect both leaf drop/yellowing and cyathia loss. Bract deterioration was not strongly affected by sleeve duration. The longer sleeve duration, (10 days), caused increased leaf drop/yellowing and cyathia loss. However, overall plant quality was good for plants sleeved for either 5 or 10 days.

Pinching time and method was shown to have a strong affect on plant growth. In both commercial trials and to a lesser extent in the trials at Efford, late pinching increased the actual cutting size, but reduced the 'vegetative' growth/size of the plant. Leaf number counts were reduced at the later pinch indicating the reduction in plant growth (results not presented). The total number of breaks was not strongly affected by pinching date, although results from the commercial trials suggest that pinching early promotes a greater number of shoots to 'break' successfully. At marketing there were no obvious differences in plant habit between plants pinched early or late.

The use of *dikegulac* as Atrinal as a chemical pinching agent on Poinsettias has not previously been evaluated in the UK. Atrinal is used within the hardy ornamental nursery stock sector to chemically prune shrubs. It works by inhibiting or removing the apical dominance of a shoot and encouraging lateral branching. The aim of the trial this year was to take a first look at its potential to replace manual pinching of Poinsettia. The potential benefit in labour saving is great. Atrinal did successfully 'pinch' Poinsettias when applied at the rate of 20 ml/l as a spray. However, its application severely affected plant vigour, and the 'breaking' of the lower shoots was much delayed to that of a manually pinched plant. Plants did reach marketing stage, and at all the rates used plants were not killed. The number of breaks which developed were considerably higher than those found by pinching manually. However, this may be attributed to the fact that there were a greater number of potential nodes for shoots to break from. As opposed to manual pinching, it was extremely difficult to time the application of Atrinal to produce a 'set' number of shoots on a plant. Further research is needed before it can be considered as a viable alternative to manual pinching in the commercial production of Poinsettias.

The effect of pinching date on floral initiation was examined through a number of dissection studies carried out by Dr Allen Langton of HRI Littlehampton. The aim was to assess the effect of pinching, either an early or late pinch, on the initiation and floral development of a number of Poinsettia cultivars. This work complimented that done in previous years at HRI Efford and HRI Littlehampton where initiation dates had been derived for a number of new Poinsettia cultivars.

The initiation dates were later in this years trial in comparison to previous studies in 1992 and 1993. Such differences could be attributed to high light levels at or around the equinox, which could cause plants to perceive a 'longer day' in comparison to dull weather conditions when initiation may be slightly earlier. However, in 1994 the light levels at the equinox were in fact no different than in the preceeding years, although light levels at 2 October were much higher. Therefore, it is unclear why the initiation dates were later this year. Also of interest was the result that flower development in earlier pinched plants was slightly slower in comparison to plants pinched later. As yet no clear explanation can be given, but it highlights the variability found in the growth of Poinsettias and between seasons.

The commercial evaluation of new Poinsettia cultivars highlighted the introduction of a wide range of new cultivars onto the UK market. The eight selected cultivars grown were all from Fischer who have produced a new and exciting range of cultivars of different shapes, colours and form. All appeared more compact than the present cultivars, they broke freely and produced a uniform plant. In shelf-life the plants did not stand up particularly well, but this may be attributed to the fact that the plants were very mature upon receipt at HRI Efford prior to the start of the shelf-life assessments. Three cultivars worthy of note which did have a better shelf-life were Sonora, Flirt and Puebla.

5. CONCLUSIONS

- Specialist media types were successfully used in the production of Poinsettias, but each requires a separate cultural/management practice to optimise its performance.

- CRFs as used in the context of this trial produced more compact plants.

- Liquid feeding Poinsettias allowed a more flexible nutrient regime to be adopted.

- Pinching date will affect plant habit; pinching earlier has the potential to produce a bigger plant and there was an indication that flower development could be delayed.

- Atrinal was successfully used as a chemical pinching agent on Poinsettias, but caused a severe delay in subsequent plant growth resulting in smaller plants a marketing.

- The length of time plants remained sleeved affected both leaf drop/yellowing and cyathia loss in shelf-life. Plants suffered greater deterioration when sleeved for 10 days.

- The range of new cultivars trialled on a commercial nursery showed good potential for commercial production with a greater range of colours and growth, and more compact habit.

- Use of NBL can be advantageous in delaying the maturity of plants nearer to the Christmas market, but additional plant growth regulations may be required to control the increased vegetative growth.

APPENDICES

Figure 3. Trial Layout Ebb and Flood Floors- Main Trial

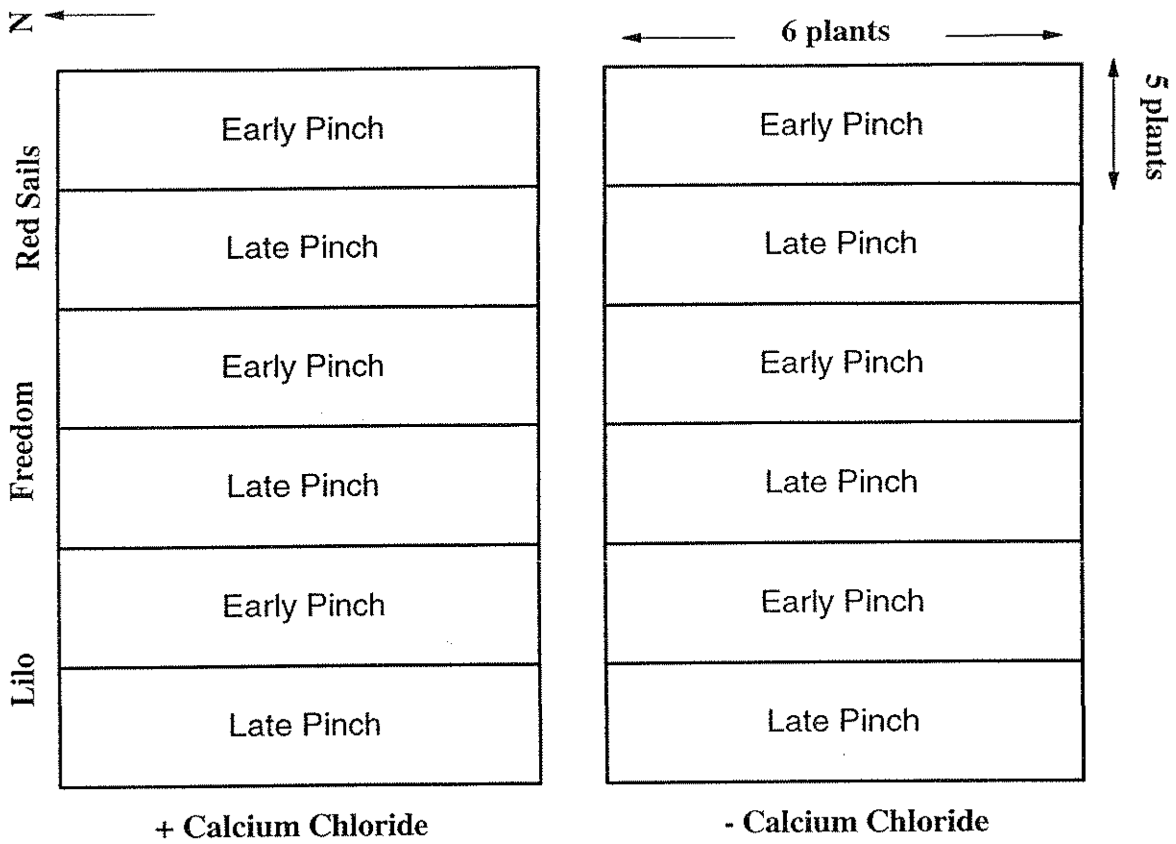


Figure 4. Trial Layout Benches with Capillary Matting - Main Trial

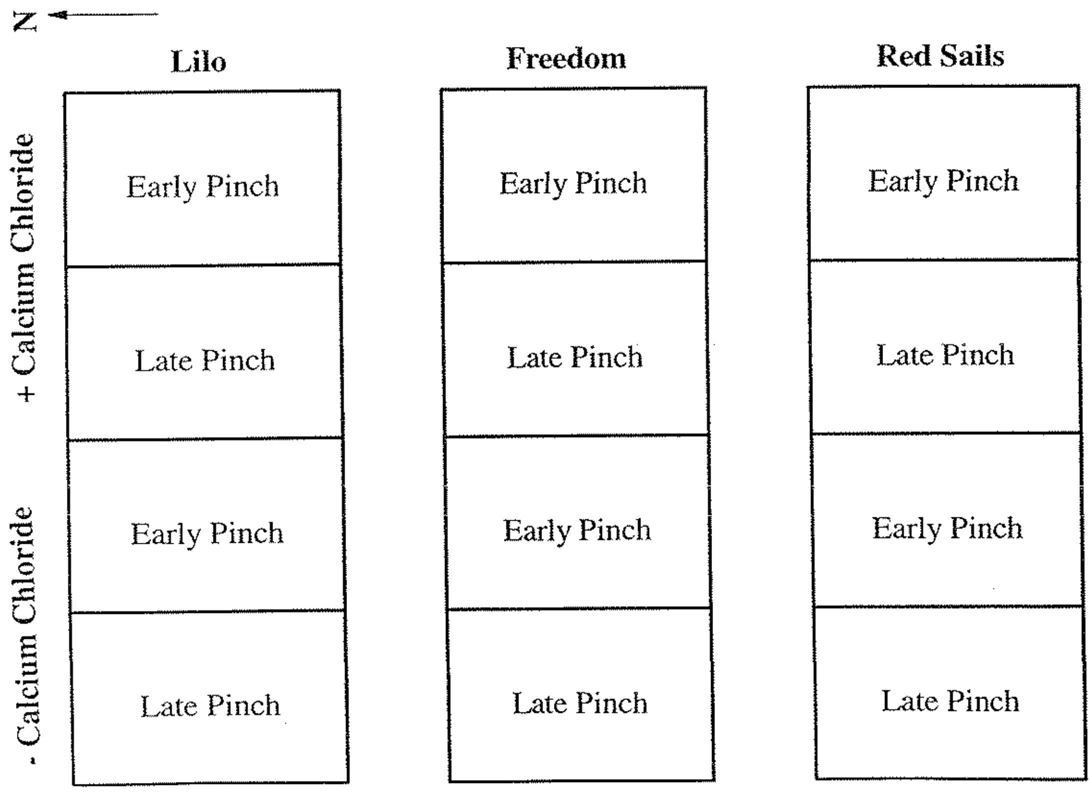


Figure 5. Trial Layout - Chemical Pinching in P Block

		Control Plants-manual pinch
15ml/l Atrinal	Red Sails	
	Lilo	
	Menorca	
	Marlene	
	Ria	
20ml/l Atrinal	Red Sails	
	Lilo	
	Menorca	
	Marlene	
	Ria	
30ml/l Atrinal	Red Sails	
	Lilo	
	Menorca	
	Marlene	
	Ria	

20 plants / plot

N

APPENDIX II

Crop Diary - Main Trial

12 August	-	plants potted
22 August	-	early pinch
30 August	-	late pinch
5 September	-	plants pinched early spaced to $34/m^2$
11 September	-	commenced liquid feed (feed 1)
15 September	-	plants pinched late spaced to $34/m^2$
7 October	-	plants pinched early and late spaced to 11/m2
26 October	-	apply calcium chloride sprays - 2.2 g/l (400 ppm)
31 October	-	commenced liquid feed (feed 2)

Pest and Disease Control Measures

Furalaxyl as Fongard was applied as a drench at the rate of 1 g/l four weeks after potting.

Encarsia formosa introduced weekly from potting at the rate of 1 per plant for control of the Glasshouse Whitefly.

Steinernema feltiae as Nemasys applied as a drench on 6 September and repeated on 30 September for control of Scarid Fly.

Cycocel applications

Date	Rate	Red Sails	Freedom	Lilo
9 September 1994	2.2 ml/litre	Pinch 1	Pinch 1	Pinch 1
18 September 1994	2.2 ml/litre	Pinch 1 + 2	Pinch 1 + 2	Pinch 1 + 2
3 October 1994	1 ml/litre	✓	-	-
8 October 1994	1 ml/litre	✓	-	-
11 October 1994	1 ml/litre	✓	-	-
14 October 1994	1 ml/litre	✓	-	-
18 October 1994	1 ml/litre	✓	-	-
21 October 1994	1 ml/litre	✓	-	-
25 October 1994	1 ml/litre	✓	-	✓
28 October 1994	1 ml/litre	✓	-	✓
1 November 1994	1 ml/litre	✓	-	✓
4 November 1994	1 ml/litre	✓	-	✓
9 November 1994	1 ml/litre	✓	✓	✓
16 November 1994	1 ml/litre	✓	✓	✓

* Final applications, 4-16 November were applied as spot treatments only.

APPENDIX III

The Flowering Stage Scale

This is based on a scale developed at Littlehampton by Jon Horridge but was amplified during the current trials.

Stage 0	Plants appear vegetative. Apex small, rather flat and circular, being closely surrounded by leaf primordia.
Stage 1	Plants reproductive. Apex assuming a triangular shape (primary cyathium) and somewhat raised above three bract initials. First signs of developing growing points (secondary cyathia) in the axils of one or two of the bracts (not the youngest). Merest hint of staminate primordial development at the tips of the primary apex.
Stage 2	Obvious growing points in the axils of all three bract initials but these still lack any obvious differentiation. An involucral initial now becoming obvious as a 'hood' at one of the corners of the primary apex. Staminate initials now obvious at all three corners.
Stage 3	Involucre now has an obvious rim all around the primary apex. Centre of the apex becoming domed as the pistillate primordium starts to develop. First signs of staminate primordia other than the original three. Bract primordia becoming obvious on the secondary cyathia.
Stage 4	Well developed involucre extending upwards from the apex as high as other floral primordia. Five or more staminate initials present plus an obvious pistillate initial.
Stage 5	Involucre now enclosing the primary cyathium but still with an obvious aperture at the tip. Secondary cyathia have well developed bracts which, in turn, subtend tertiary cyathia initials.
Stage 6	Involucre fully enclosing the primary cyathium, frequently with the aperture 'plugged' by the upwards growth of the pistil.

APPENDIX IV Plant Growth Assessments - Main Trial HRI Efford

Table 9 Effect of media type and nutrient regime on final plant height (cm)

Cultivar	Treatment A	A+	B	B+	C	C+	Mean
Red Sails	28.6	28.9	27.4	25.3	28.2	29.0	27.9
Freedom	25.3	27.6	26.0	23.4	26.4	28.0	26.1
Lilo	25.5	26.1	25.3	23.3	25.7	26.2	25.3
Mean	26.5	27.5	26.2	24.0	26.8	27.7	

NB: + = plants grown using CRFs

Table 10 Effect of media type and nutrient regime on final plant mean diameter (cm)

Cultivar	Treatment A	A+	B	B+	C	C+	Mean
Red Sails	43.0	43.3	43.3	37.4	43.3	42.7	42.2
Freedom	39.5	37.5	37.9	34.8	39.5	37.1	37.7
Lilo	42.0	39.5	40.0	35.3	41.3	40.0	39.7
Mean	41.5	40.1	40.0	35.8	41.4	40.0	

NB: + = plants grown using CRFs

Table 11 Effect of media type and nutrient regime on the mean number of breaks per plant

Cultivar	Treatment A	A+	B	B+	C	C+	Mean
Red Sails	5.50	5.60	5.78	5.68	5.50	5.85	5.65
Freedom	6.00	6.25	5.90	5.90	6.20	6.15	6.06
Lilo	5.45	5.48	5.60	5.60	5.78	5.33	5.54
Mean	5.65	5.77	5.76	5.72	5.80	5.79	

NB: + = plants grown using CRFs

APPENDIX IV Plant Growth Assessments - Main Trial HRI Efford

Table 12 Effect of media type and nutrient regime on mean bract size of Freedom

Treatment	Percentage of bracts in each size category Bract size (cm) > 22.5	> 20.0	> 15.0	<15.0	Total No Bracts
A	29	36	25	10	6.1
A+	24	39	27	10	6.3
B	26	39	27	8	5.9
B+	22	30	27	21	5.9
C	22	39	27	13	5.9
C+	13	31	32	24	6.2

Table 13 Effect of media type and nutrient regime on mean bract size of Red Sails

Treatment	Percentage of bracts in each size category Bract size (cm) > 22.5	> 20.0	> 15.0	<15.0	Total No Bracts
A	2	25	47	25	5.5
A+	2	19	44	35	5.6
B	1	27	49	23	5.8
B+	6	27	36	31	5.7
C	2	18	52	28	5.5
C+	1	14	52	33	5.8

Table 14 Effect of media type and nutrient regime on mean bract size of Lilo

Treatment	Percentage of bracts in each size category Bract size (cm) > 22.5	> 20.0	> 15.0	<15.0	Total No Bracts
A	3	25	48	23	5.5
A+	2	26	44	27	5.5
B	0	23	49	28	5.6
B+	2	19	42	37	5.6
C	2	25	48	25	5.3
C+	0	10	51	39	5.8

NB: + = plants grown using CRFs

APPENDIX IV Plant Growth Assessments - Main Trial HRI Efford

Table 15 **Effect of media type and nutrient regime on plant quality at marketing**

	Treatment						
Cultivar	**A**	**A+**	**B**	**B+**	**C**	**C+**	**Mean**
Red Sails	1.4	1.43	1.60	1.43	1.63	1.63	1.63
Freedom	1.6	1.43	1.55	1.45	1.48	1.43	1.49
Lilo	1.43	1.45	1.48	1.28	1.33	1.58	1.42
Mean	1.48	1.44	1.54	1.39	1.48	1.55	

NB: + = plants grown using CRFs.

Table 16 **Effect of media type and nutrient regime on plant unevenness**

	Treatment						
Cultivar	**A**	**A+**	**B**	**B+**	**C**	**C+**	**Mean**
Red Sails	55.0	32.5	25.0	55.0	45.0	37.5	41.6
Freedom	22.5	30.0	12.5	3.5	17.5	37.5	18.6
Lilo	47.5	35.0	52.5	52.5	62.5	35.0	47.5
Mean	41.6	32.5	30.0	47.5	41.6	36.6	

NB: + = plants grown using CRFs. Unevenness score = as a % of crop.

APPENDIX V Growing Media Composition

ICI		STENDER		EGO	
20%	Black Peat	70%	Brown Peat	25%	Black Peat
30%	0-10 mm	10%	Clay	15%	Irish Peat
25%	6-12 mm	20%	Coconut Fibre	25%	White Peat
15%	3-6 mm	0.5 kg	NPK14-16-18	25%	Swedish Peat
10%	Perlite	150 g	Radigen	10%	Perlite
1 kg	PG Mix 14:16:18 + traces	100 g	Natium Molybdate	1 kg	PG Mix 14:16:18 + traces
Ground Limestone				Ground Limestone	
pH	5.5-5.8	pH	5.8-6.0	pH	5.5-5.7

APPENDIX VI Growing Media Analyses

Table 17 Analysis* of each substrate type at potting

		A ICI	B STENDER	C EGO
Conductivity	µs/20°C	184	330	149
pH		5.6	6.6	5.5
Nitrate (as N)	mg/l	52	40	40
Ammonium (as N)	mg/l	24.6	82.3	20.2
Phosphorus	mg/l	53	24	85
Potassium	mg/l	122	148	39
Calcium	mg/l	44	85	34
Magnesium	mg/l	17	12	16
Iron	mg/l	2.49	9.67	2.68
Zinc	mg/l	1.02	2.27	0.39
Manganese	mg/l	0.12	1.13	0.10
Copper	mg/l	0.10	0.22	0.07
Boron	mg/l	0.25	0.31	<0.01
Sodium	mg/l	18	30	12
Chloride	mg/l	17	36	3
Sulphate (as S)	mg/l	38	113	27
Bulk density	g/ml	0.277	0.220	0.161

* Water available - extractable analysis

APPENDIX VI Growing Media Analyses

Table 18 Media analysis on 12 October 1994

		A	A+	B	B+	C	C+
Conductivity	µs/20°C	231	376	414	565	242	344
pH		5.4	5.0	5.8	4.7	5.5	5.2
Nitrate (as N)	mg/l	106	182	196	303	117	162
Ammonium (as N)	mg/l	4	1.9	1.1	2.3	2.7	3.0
Potassium	mg/l	144	180	162	216	126	138
Calcium	mg/l	77	168	279	409	92	147
Magnesium	mg/l	29	69	27	52	42	75
Phosphorus	mg/l	19	41	19	43	17	43
Iron	mg/l	0.51	1.13	6.39	3.42	0.43	0.79
Zinc	mg/l	1.81	0.65	1.82	1.08	0.51	1.31
Manganese	mg/l	0.03	0.19	0.06	0.76	0.05	0.24
Copper	mg/l	0.06	0.04	0.09	0.10	0.01	0.04
Boron	mg/l	0.26	0.35	0.34	0.53	0.02	0.14
Sodium	mg/l	54	66	78	90	54	60
Chloride	mg/l	72	108	84	96	78	84
Sulphate (as S)	mg/l	20	45	68	92	20	46
Bulk density	g/ml	0.33	0.36	0.39	0.32	0.33	0.22

* Water available - extractable analysis
\+ = with CRF

APPENDIX VI Growing Media Analyses

Table 19 Media analysis* on 3 December 1994

		A	A+	B	B+	C	C+
Conductivity	$\mu s/20^{\circ}C$	386	251	259	555	254	280
pH		5.4	5.4	6.1	5.2	6.2	6.0
Nitrate (as N)	mg/l	184	64	105	213	109	87
Ammonium (as N)	mg/l	6.6	8.8	4.4	10.3	6.0	6.3
Potassium	mg/l	180	114	108	210	114	114
Calcium	mg/l	186	98	171	422	111	122
Magnesium	mg/l	45	31	11	41	34	47
Phosphorus	mg/l	29	41	12	86	12	40
Iron	mg/l	0.24	0.52	9.47	3.94	0.22	0.32
Zinc	mg/l	1.46	1.84	0.52	1.37	0.55	1.61
Manganese	mg/l	0.15	0.11	0.07	0.92	0.04	0.14
Copper	mg/l	0.06	0.08	0.04	0.08	0.05	0.07
Boron	mg/l	0.09	0.32	0.11	0.33	0.06	0.06
Sodium	mg/l	90	78	60	72	72	66
Chloride	mg/l	-	-	-	-	-	-
Sulphate (as S)	mg/l	16	27	26	70	5	39
Bulk density	g/ml	0.28	0.29	0.34	0.35	0.29	0.36

* Water available - extractable analysis
\+ = with CRF

APPENDIX VI Growing Media Analyses

Table 20 Media analysis* on 13 December 1994

		A	A+	B	B+	C	C+
Conductivity	µs/20°C	227	147	217	370	218	217
pH		5.8	6.3	6.6	5.8	6.4	6.6
Nitrate (as N)	mg/l	102	8	80	123	97	29
Ammonium (as N)	mg/l	0.9	1.3	0.9	2.4	1.0	1.6
Potassium	mg/l	98	46	91	130	112	60
Calcium	mg/l	121	57	155	297	96	101
Magnesium	mg/l	29	17	9	30	27	36
Phosphorus	mg/l	17	15	9	37	8	24
Iron	mg/l	0.06	0.06	7.25	2.86	0.06	0.06
Zinc	mg/l	0.53	0.49	0.28	0.61	0.48	1.18
Manganese	mg/l	0.05	0.08	0.04	0.17	0.02	0.04
Copper	mg/l	0.02	0.08	0.02	0.08	0.04	0.10
Boron	mg/l	0.21	0.53	0.23	0.44	0.05	0.15
Sodium	mg/l	42	60	36	54	54	72
Chloride	mg/l	-	-	-	-	-	-
Sulphate (as S)	mg/l	21	41	30	84	16	35
Bulk density	g/ml	0.32	0.28	0.31	0.38	0.31	0.37

* Water available - extractable analysis
\+ = with CRF

APPENDIX VI Growing Media Analyses

Table 21 Media analysis* on 19 December 1994

		A	A+	B	B+	C	C+
Conductivity	µs/20°C	286	206	255	180	202	244
pH		5.6	6.2	6.4	5.4	6.5	6.4
Nitrate (as N)	mg/l	146	20	103	182	96	39
Ammonium (as N)	mg/l	0.5	0.8	0.7	1.1	0.7	0.7
Potassium	mg/l	119	41	107	181	94	41
Calcium	mg/l	155	98	172	397	92	126
Magnesium	mg/l	35	33	11	42	27	47
Phosphorus	mg/l	18	19	6	44	5	15
Iron	mg/l	0.01	<0.01	1.33	0.97	<0.01	<0.01
Zinc	mg/l	0.59	0.96	0.94	1.59	0.66	1.28
Manganese	mg/l	0.08	0.05	0.04	0.66	0.03	0.05
Copper	mg/l	0.03	0.10	0.04	0.10	0.03	0.12
Boron	mg/l	<0.01	0.15	<0.01	0.19	<0.01	<0.01
Sodium	mg/l	60	72	54	72	54	84
Chloride	mg/l	-	-	-	-	-	-
Sulphate (as S)	mg/l	18	54	33	91	10	52
Bulk density	g/ml	0.26	0.27	0.38	0.37	0.31	0.19

* Water available - extractable analysis
\+ = with CRF

Figure 6. Weekly nutrient level readings - liquid feed nutritional programme

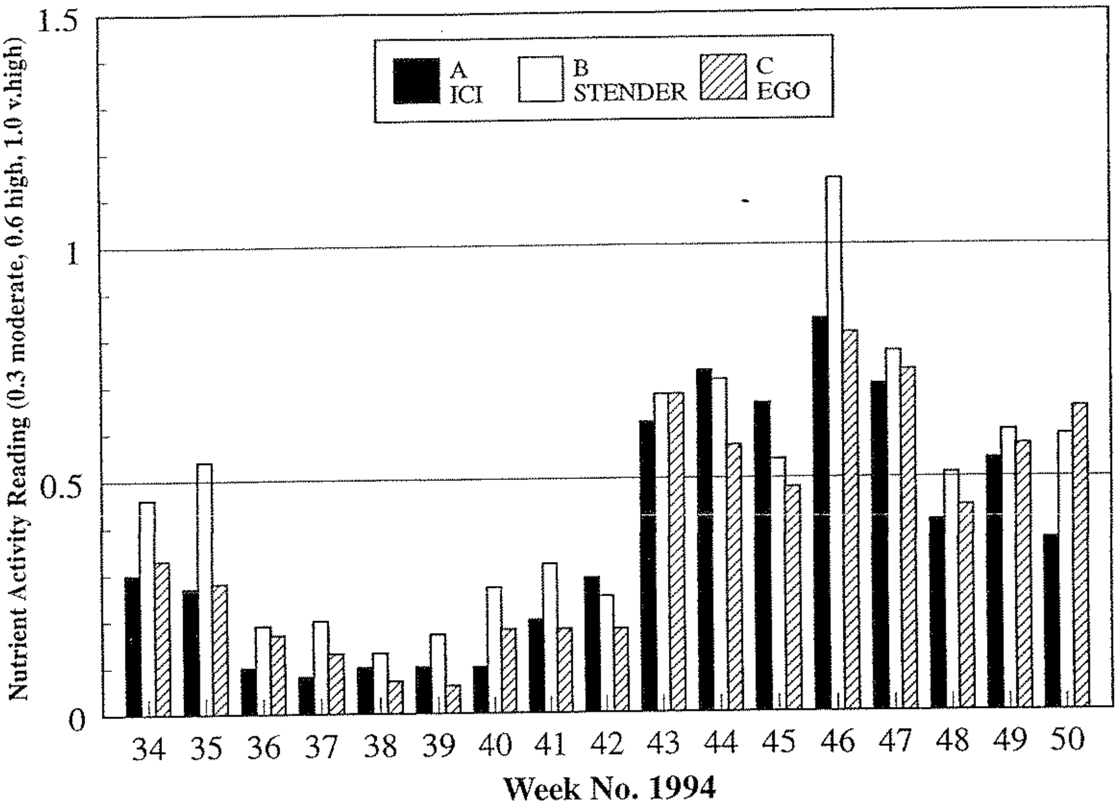
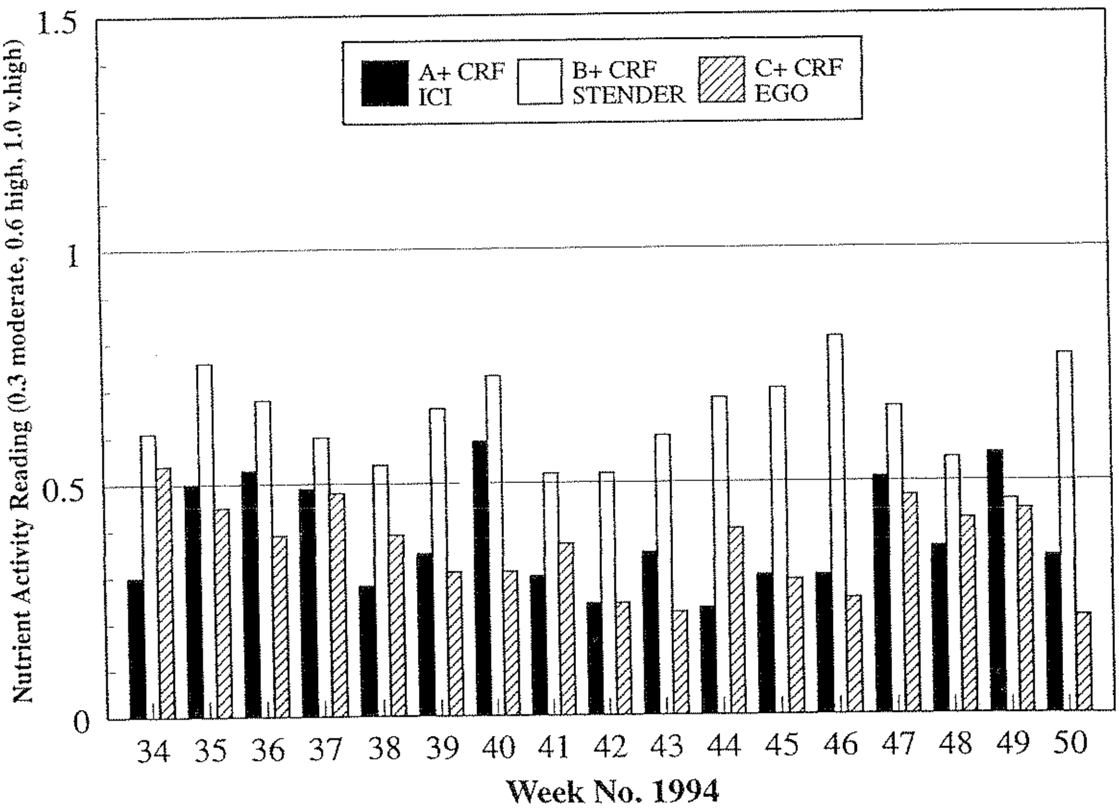


Figure 7. Weekly nutrient level readings - CRF nutritional programme



The AM PET 2000 indicates:

Dissolved nutrients = ions in the soil and solution
Pot plants, bed plants, container plants, compost, beds in open area and in hothouses, cultural soil mixtures, nurseries can be checked in only a few seconds.
Roses, carnations, large container plants are for the most part sufficiently fertilized in the top-soil, but not necessary so in deeper layers.
Pot plants with a complex root network take up liquid fertilizer within a few hours. Plants which require smaller quantities of nourishment (primula acaulis) are usually over-fertilized.
Vegetables grown under glass are often over-fertilized, in open areas they often receive too little water.
In landscape gardening water-logged soil causes complete losses. Damages from street-salt are a great problem in the countryside.

Time of top-gressing
In the course of the growing time the gardener has to ascertain whether longterm fertilizer is still flowing, whether the supply of fertilizer is still sufficient, or, because of a high fertilizer content, another suitable action has to be taken.When the values are too low, top-dressing is necessary. Top plants are fertilized with solutions. Open land or bed plants are fertilized with nitrogen or nitrogen and kalium. A quick nitrogen test with the N-Test aids the decision.

Time of soil tests
High values are maintained by the plants for only a short time. If those do not change in the long term, a soil test is then necessary to ascertain the disequilibrium of the elements.

Dryness and water-logged soil
In case of dryness there is no indication.
In case of water-logged soil the indicated values increase 5 to 10 times in the toxic area. The reason being the decay of the colloids, when the ions loose their previous electric connection.

Instructions
Attach the electrode to the apparatus and insert the electrode into the wet soil. The whole measuring point of the electrode (black end) must be covered.

75cm and 30cm electrode: measuring point 8 cm
25cm electrode: measuring point 3 cm

Press the button - read off the value. The first value is valid.
Repeat the process at least five times in different places for an average reading.
Measuring in open areas, beds and forest land
The measurement should always be made in the same layer and moisture of the soil.
Measuring in loose soil and substrates

Place moist soil in a container, put down and measure.

General recommendation

If the soil or substrate has been watered before hand, the measuring should be repeated about 60 minutes later.
Several longterm fertilizers (Osmocote) absorb the most nutrients at high temperature, therefore the time of measuring plays an important role.

Why measure nutrient activity in the soil?

The activity-meter PET 2000 indicates the dissolved salt-ions in the soil. Chemically, activity is the effectiveness of the ions. The dissolved salt-ions are divided into positively charged cat-ions and negatively-charged an-ions. In pure water, the electrically-charged ions are immediately dissolved completely. In the soil, the ions loose a considerable amount of the mobility they maintain in water, and thus their effectiveness decreases. This decrease is calculated as follows:

1) dxfb = a   d= density= concentration in g/litre soil
fb= activity coefficient (grade of effectiveness)
a= activity in g/litre soil=effective ion quantity

Scaale of the activity in the soil

activity g/litre	establishment of the values	the intake of elements by plants a) high fb-value (N,Cl,S)	b) medium (K,Na,Ca, Mg,B,Mo)	c) low fb-value P,Fe,Mn, Zn,Cu,Al)
0 -0,05	very low	insufficient	checked	greatly restrict
0.05-0,1	low	moderate	too slow	insufficient
0,1--0,2	moderate	sufficient	moderate	too slow
0,2 -0,4	medium	good	sufficient	moderate
0,4 -0,8	high	very good	good	good
0,8 -1,2	very high	very good	very good	very good
1,2 -1,4	too high	too strong	unharmonious	unharmonious
1,5	toxic	visible toxic symptoms, toxic scale		

It is the activity, not the quantity ot the salt ions int the soil, which determines all chemical and physical reactions. This also applies to the nutrient intake of the plants. Therefore it is important to determine the activity of the dissolved elements in the soil and not their quantity.

Measuring of the activity

A constant electric current is sent into the soil by means of an electrode. The current conducts the nutrients, which are ions, to the poles of the electrode. The electrode takes up the electric charge of the nutrients and therefore they dissappear from the soil. Since the conditions of the soil are the same in both cases, the sum of all attributes of the soil is included in the measuring. The measurement value which is simply indicated as activity in g/litre shows the activity of all ions or nutrients flowing in the soil. The values given in the table are valid for the main-growing time. In the flowering and maturity time the values should not fall below 0,1. The values are valid at a soil temperature of 18-20° C. 1°C change the value of about 2,5%.

In all fields of plantation, horticulture, landscape gardening, nursery etc. the instrument is applied to decide which cultivation actions have to be taken, to control and test actions having already been taken or being planned and it contributes to an optimal crop.
The PET 2000 makes an important contribution to the protection of the environment.

Control of fertilizer- and nutritive solutions g/litre salt

Fertilizer mixer, fertilizer systems , can be tested for the content of salt. It is absolutely necessary that the gardener knows the salt content of the water being used. rain water has a value of 0,02 - 0,1. Water to be used should have a value of 0,1 - 0,3. If the salt content exceeds 0,3, a water test should be made.

Use in hydro-cultivation

High salt contents can be fixed immediately. A bad water or a high salt content often cause bad growing and damages.

Scale of fertilizer- and nurtitive solutions

When measuring solutions permanently move electrode slightly

g salt/1litre H_2O	activity g/litre at 20°C	
1g	0,9-0,95	plus value
2g	1,4-1,5	
3g	1,6-1,7	of applied water
5g	1,9-2,0	
10g	2,2-2,3	
20g	2,5-2,6	

Calculation table

The relation conductivity, measured in siemens, to activity is demonstrated in the table as follows. Conductivity is measured in siemens (S) or, international, in mho.

1 Siemens (S) = 1/Ohm = 1 mho
1/1000 Siemens = 1 Millisiemens (mS) = 1 mmho
1/1000 000 Siemens = 1 Mikrosiemens (µS) = 1 µmho

Salzmenge g/Liter	mS/cm oder mmho	µS/CM oder µmho/cm	Aktivität g/Liter
0 -0,10	0 -0,16	0- 160	0 -0,1
0,10-0,50	0,16-0,80	160- 800	0,1 -0,45
0,50-0,75	0,80-1,30	800-1300	0,45-0,65
0,75-1,00	1,30-1,60	1300-1600	0,65-0,90
1,00-1,50	1,60-2,20	1600-2200	0,90-1,20
1,50-2,00	2,20-2,50	2200-2500	1,20-1,50

The specific conductivity refers to an electrode position difference of 1 cm, therefore it is expressed in mS/cm or µS/cm.

APPENDIX IX Leaf Tissue Analysis

Table 22 Leaf tissue analysis on 26 October 1994

Treatment		A			A+			B			B+			C			C+		
Cultivar		Lilo dom	Free-Sails	Red	Lilo dom	Free-Sails	Red	Lilo dom	Free-Sails	Red	Lilo dom	Free-Sails	Red	Lilo dom	Free-Sails	Red	Lilo dom	Free-Sails	Red
Nitrogen	%	4.86	4.52	4.37	4.59	4.30	4.37	4.64	4.22	4.61	4.82	4.61	3.86	4.52	4.09	4.43	4.43	3.86	4.38
Phosphorus	%	0.73	0.70	0.80	0.65	0.77	0.62	0.64	0.64	0.69	0.75	0.69	0.62	0.69	0.67	0.75	0.81	0.54	0.76
Potassium	%	4.03	3.43	3.69	3.80	3.27	3.41	4.05	3.28	3.93	3.91	2.91	3.74	3.67	3.28	3.75	3.97	2.54	3.33
Calcium	%	0.78	0.71	1.06	0.89	0.84	0.76	1.21	1.03	1.34	1.22	1.45	1.57	0.76	0.96	0.72	1.08	0.81	0.98
Magnesium	%	0.51	0.46	0.57	0.53	0.53	0.53	0.40	0.38	0.43	0.46	0.50	0.42	0.53	0.58	0.48	0.65	0.54	0.63
Manganese	mg/kg	74.5	48.16	84.8	65.14	106.4	76.0	63.6	51.4	75.24	170.4	278.3	189.7	96.4	115.6	86.5	142.1	93.3	122.5

N.B. + = with CRF

Table 23 Leaf tissue analysis on 20 December, cv Red Sails

Media/Nutrient Treatment		A		A+		B		B+		C		C+	
Calcium Spray		+	-	+	-	+	-	+	-	+	-	+	-
Nitrogen	%	2.90	3.00	2.74	2.75	2.98	2.93	3.07	3.02	3.33	3.42	3.04	3.02
Phosphorus	%	0.57	0.58	0.55	0.58	0.59	0.56	0.59	0.56	0.54	0.56	0.59	0.56
Potassium	%	3.83	3.68	3.38	3.65	3.62	3.73	3.69	3.64	3.70	3.63	3.50	3.31
Calcium	%	0.30	0.43	0.40	0.43	0.35	0.36	0.32	0.47	0.45	0.36	0.38	0.43
Magnesium	%	0.27	0.29	0.33	0.31	0.24	0.24	0.24	0.24	0.29	0.29	0.33	0.34
Manganese	mg/kg	17.9	20.6	20.9	20.1	18.76	18.3	28.2	31.5	18.6	19.7	21.3	21.7

N.B. A+, B+, C+ = with CRF
+/- = with or without calcium spray

APPENDIX IX Leaf Tissue Analysis

Table 24 Leaf tissue analysis on 3 December, cv Freedom

Media/Nutrient Treatment		A		A+		B		B+		C		C+	
Calcium Spray		+	-	+	-	+	-	+	-	+	-	+	-
Nitrogen	%	3.58	3.62	3.17	3.23	3.51	3.39	3.34	3.47	3.79	3.64	3.51	3.45
Phosphorus	%	0.70	0.71	0.73	0.73	0.69	0.61	0.65	0.63	0.77	0.74	0.63	0.66
Potassium	%	4.33	3.87	4.25	3.97	4.09	4.06	3.31	3.45	4.42	3.95	3.56	3.87
Calcium	%	0.33	0.26	0.35	0.35	0.31	0.34	0.29	0.33	0.31	0.31	0.26	0.25
Magnesium	%	0.27	0.29	0.32	0.33	0.27	0.25	0.27	0.28	0.32	0.32	0.32	0.30
Manganese	mg/kg	17.6	16.34	17.2	18.7	16.75	15.56	24.9	22.3	16.7	18.6	13.96	15.01

N.B. A+, B+, C+ = with CRF
+/- = with or without calcium spray

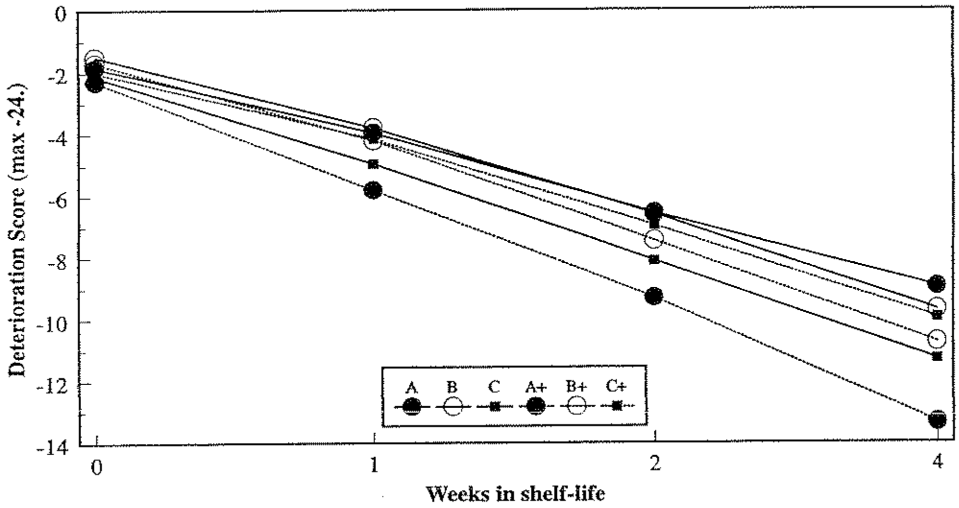
Table 25 Leaf tissue analysis on 13 December, cv Lilo

Media/Nutrient Treatment		A		A+		B		B+		C		C+	
Calcium Spray		+	-	+	-	+	-	+	-	+	-	+	-
Nitrogen	%	3.33	3.43	3.41	3.01	2.99	3.6	3.38	3.47	3.64	3.52	3.36	3.09
Phosphorus	%	0.55	0.59	0.58	0.63	0.59	0.58	0.51	0.56	0.50	0.56	0.59	0.55
Potassium	%	3.79	3.98	3.59	3.91	4.38	3.67	3.34	3.44	3.65	3.70	3.37	3.57
Calcium	%	0.26	0.31	0.34	0.36	0.33	0.27	0.32	0.33	0.23	0.21	0.26	0.34
Magnesium	%	0.27	0.28	0.32	0.30	0.25	0.26	0.26	0.28	0.27	0.28	0.33	0.32
Manganese	mg/kg	18.1	22.3	23.0	19.5	18.5	19.5	27.4	26.8	16.4	17.7	22.0	20.0

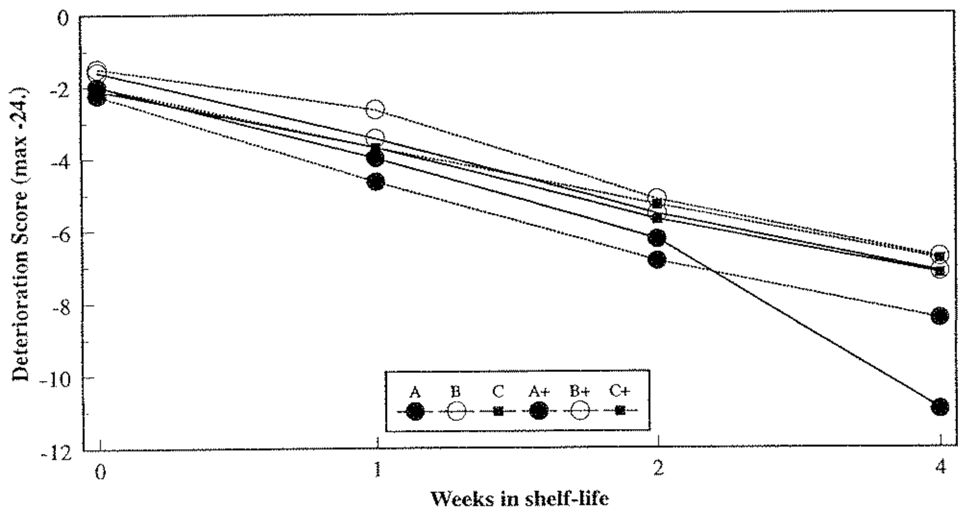
N.B. A+, B+, C+ = with CRF
+/- = with or without calcium spray

Figure 8. Effect of media type and nutrient regime on shelf-life cv. Freedom

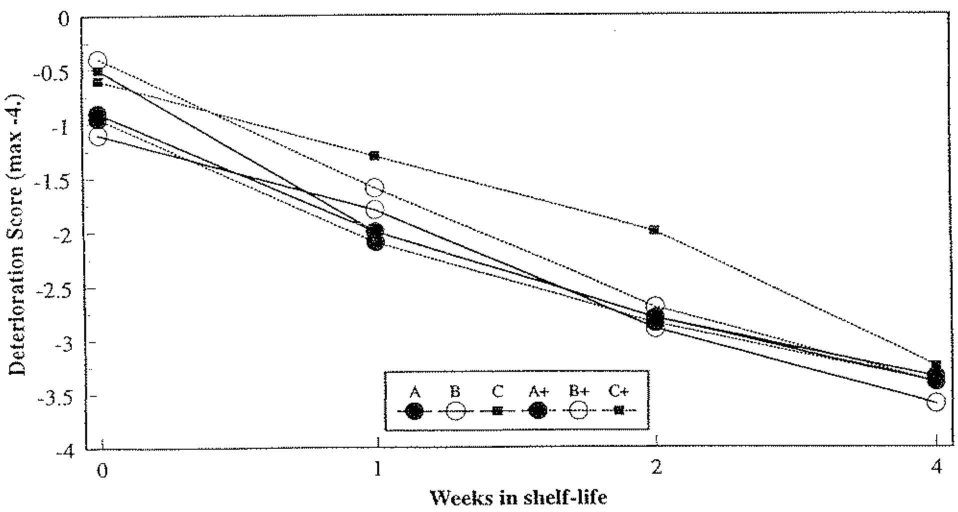
Bract Deterioration



Leaf Drop and Yellowing

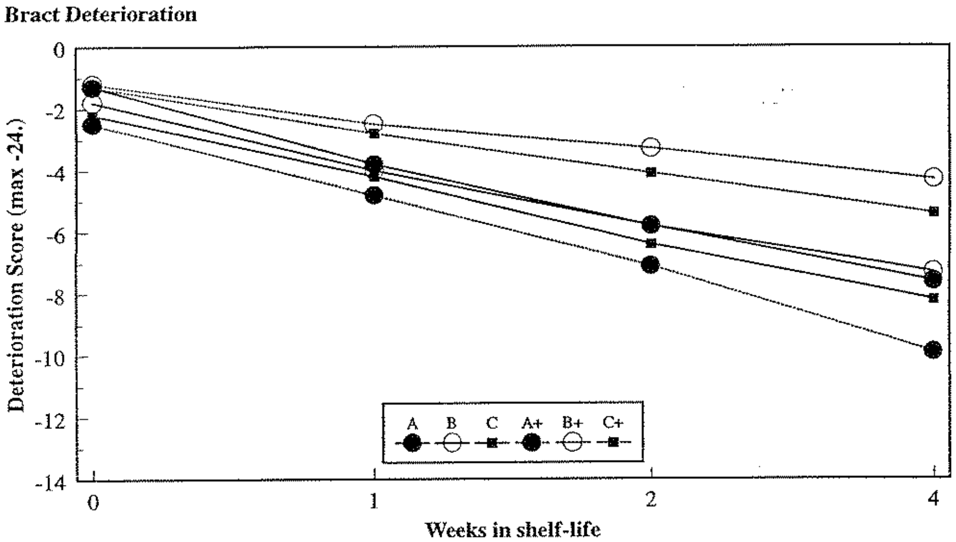


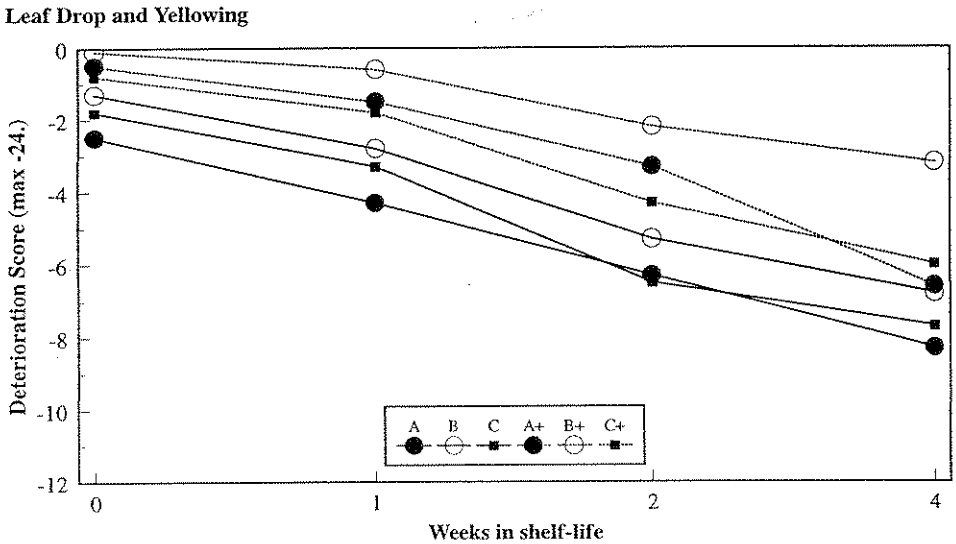
Cyathia Loss

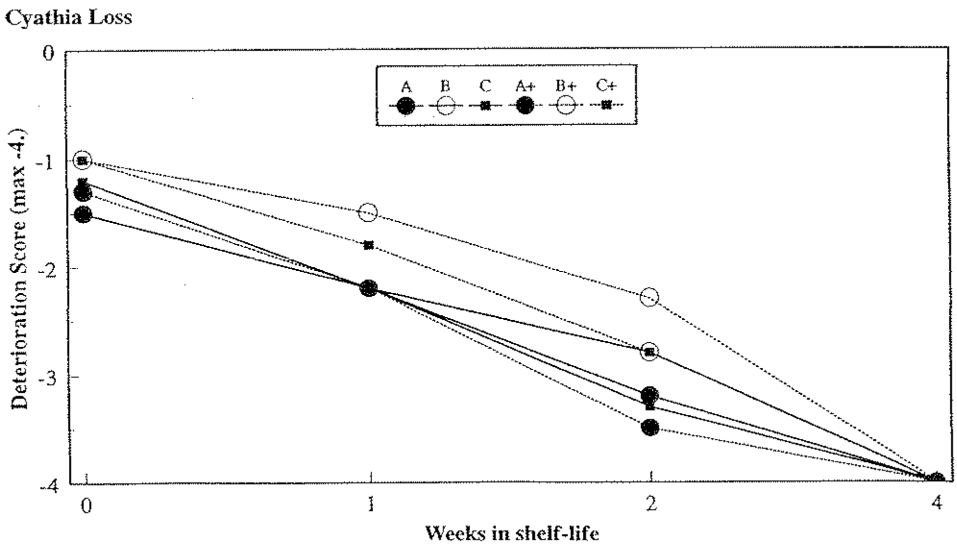


A=ICI, B=Stender, C=EGO (+= with CRF)

Figure 9. Effect of media type and nutrient regime on shelf-life cv. Lilo

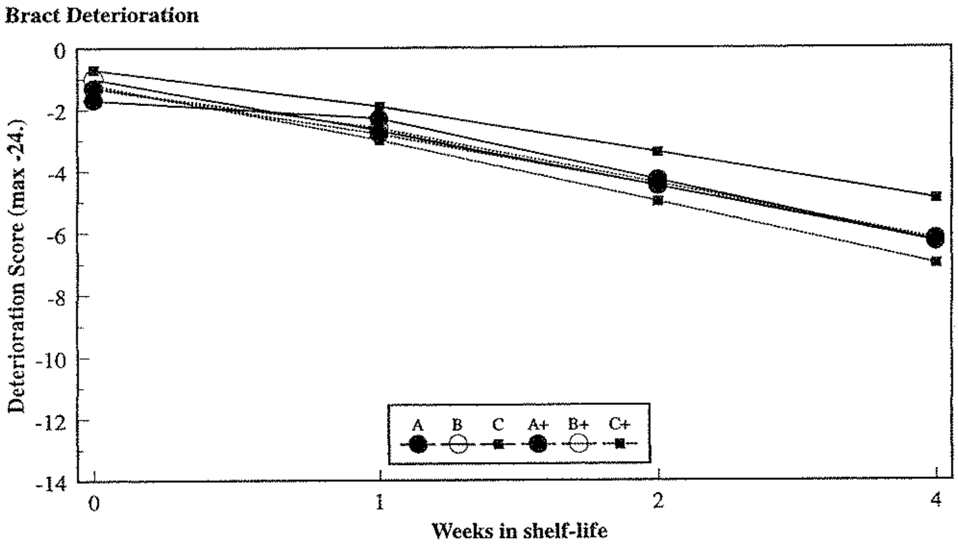


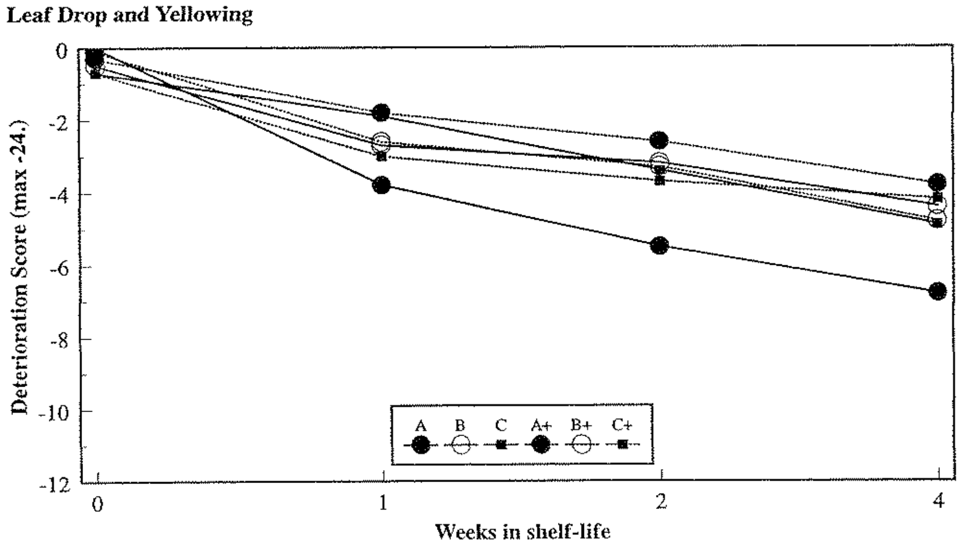


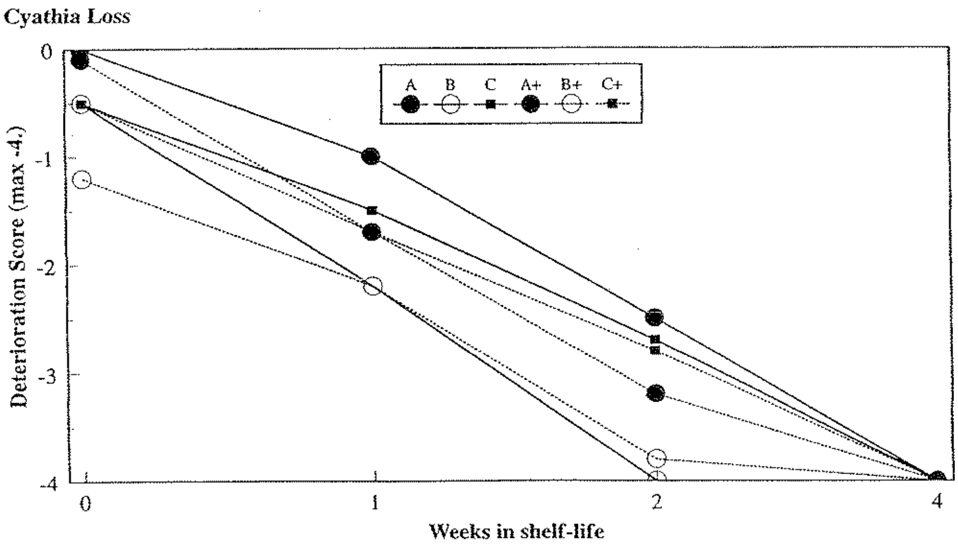


A=ICI, B=Stender, C=EGO (+ = with CRF)

Figure 10. Effect of media type and nutrient regime on shelf-life cv. Red Sails



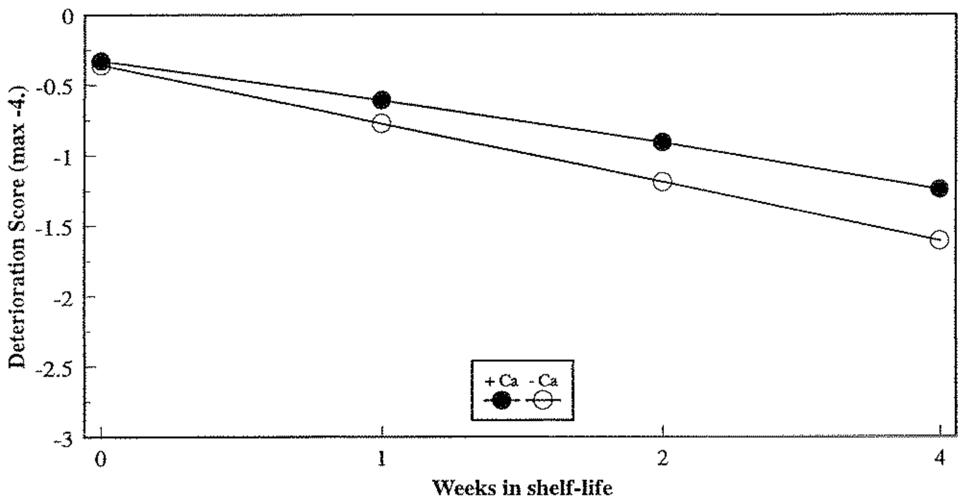




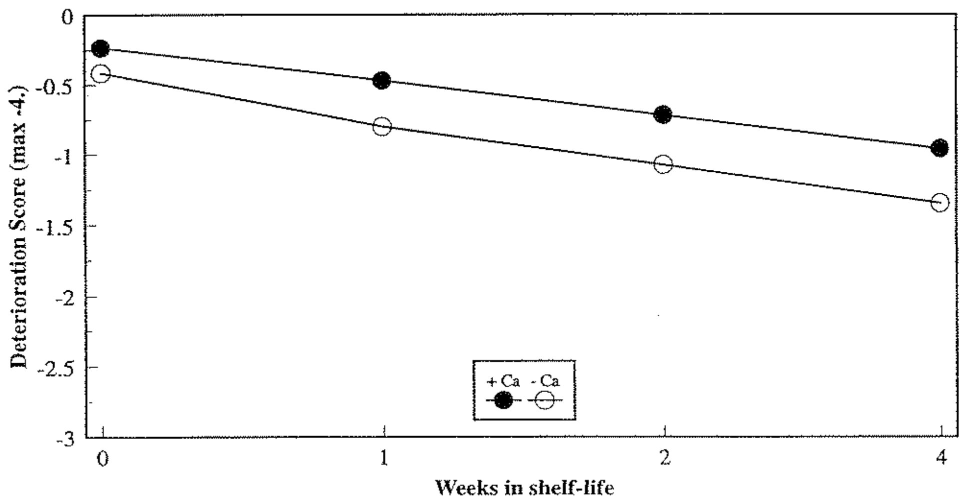
A=ICI, B=Stender, C=EGO (+ = with CRF)

Figure 11. Effect of calcium sprays on bract necrosis

cv. Freedom



cv. Red Sails



cv. Lilo

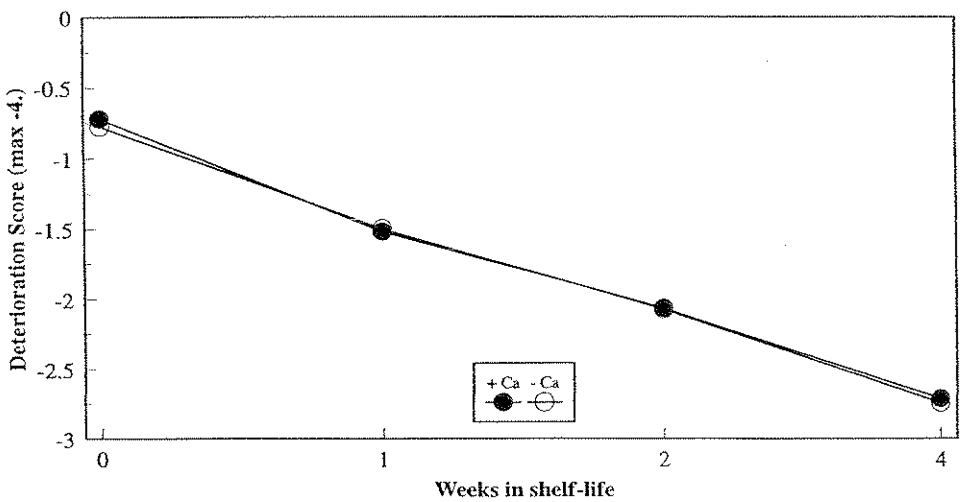
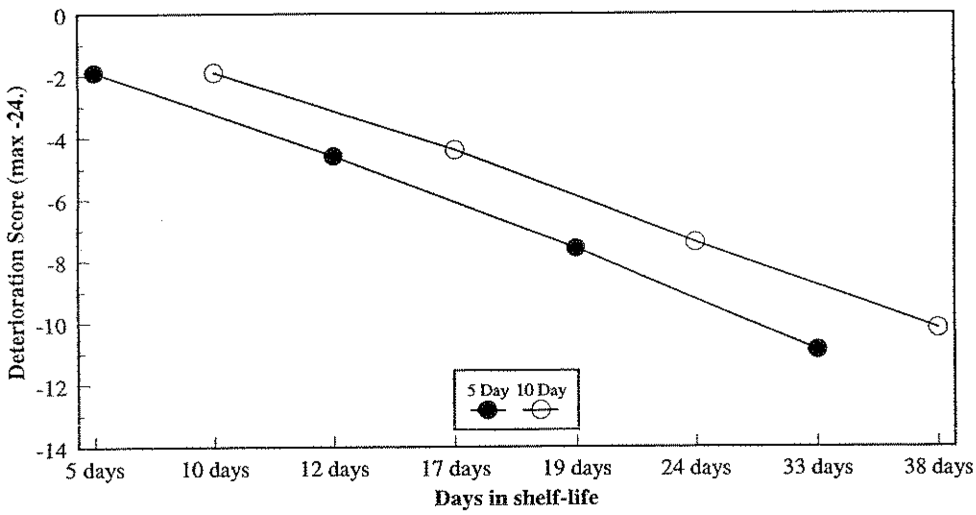
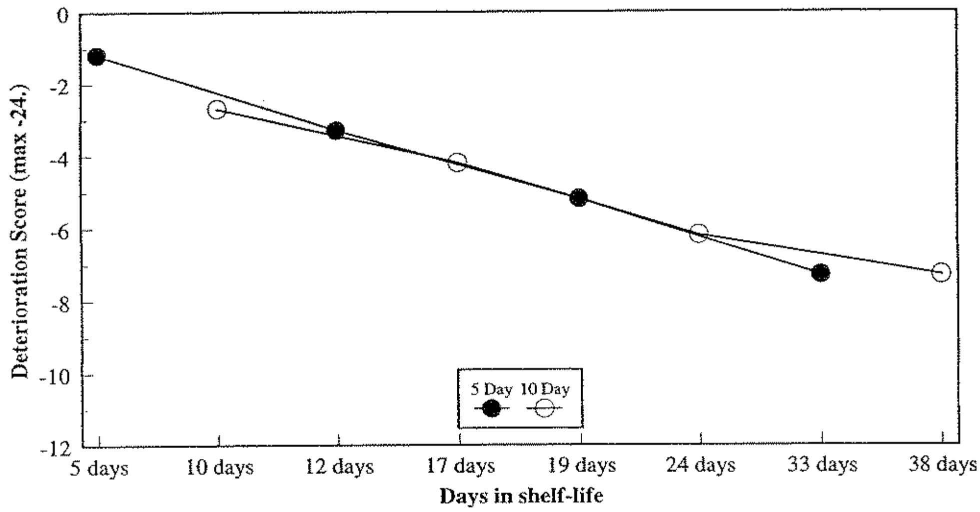


Figure 12. Effect of sleeve duration on shelf-life cv. Freedom

Bract Deterioration



Leaf Drop and Yellowing



Cyathia Loss

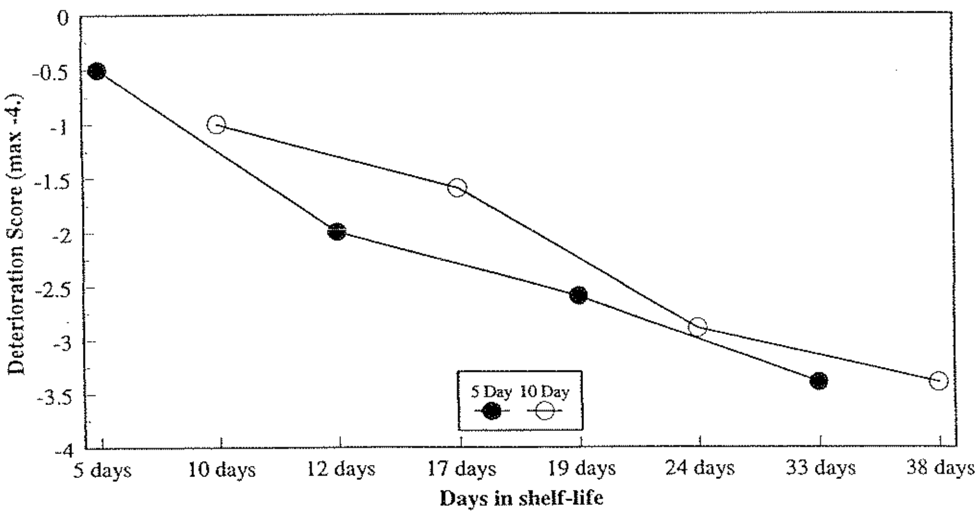
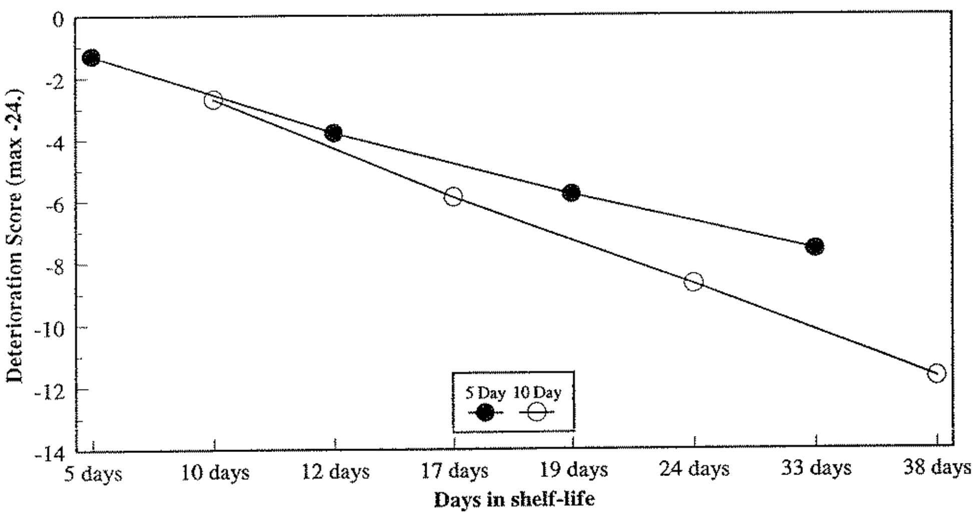
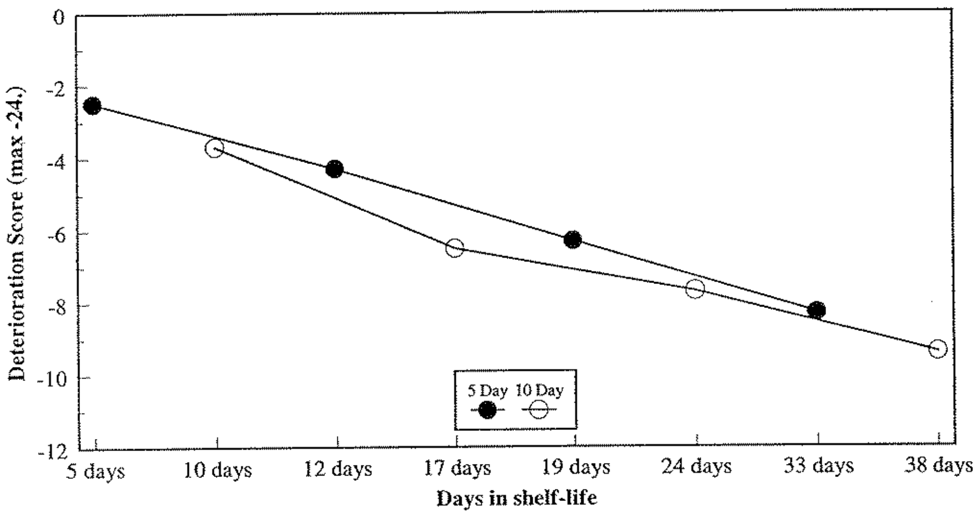


Figure 13. Effect of sleeve duration on shelf-life cv. Lilo

Bract Deterioration



Leaf Drop and Yellowing



Cyathia Loss

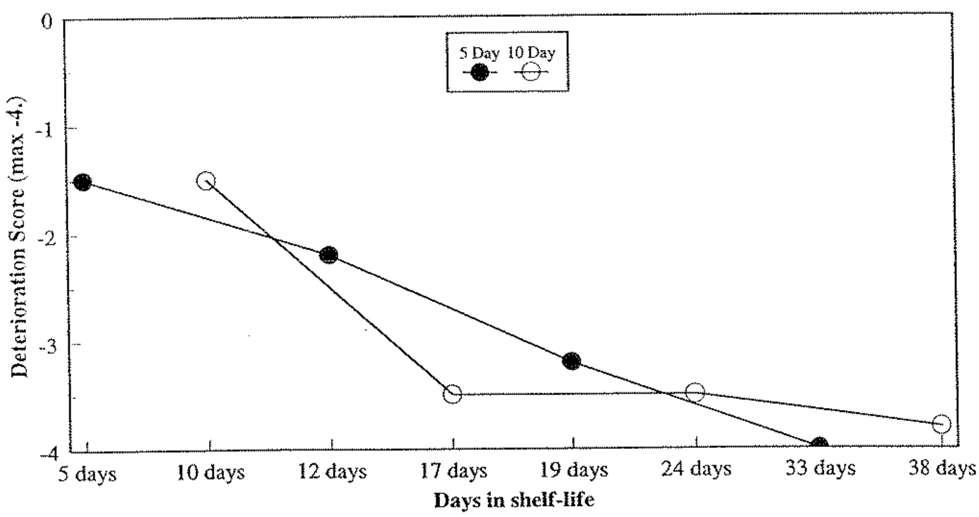
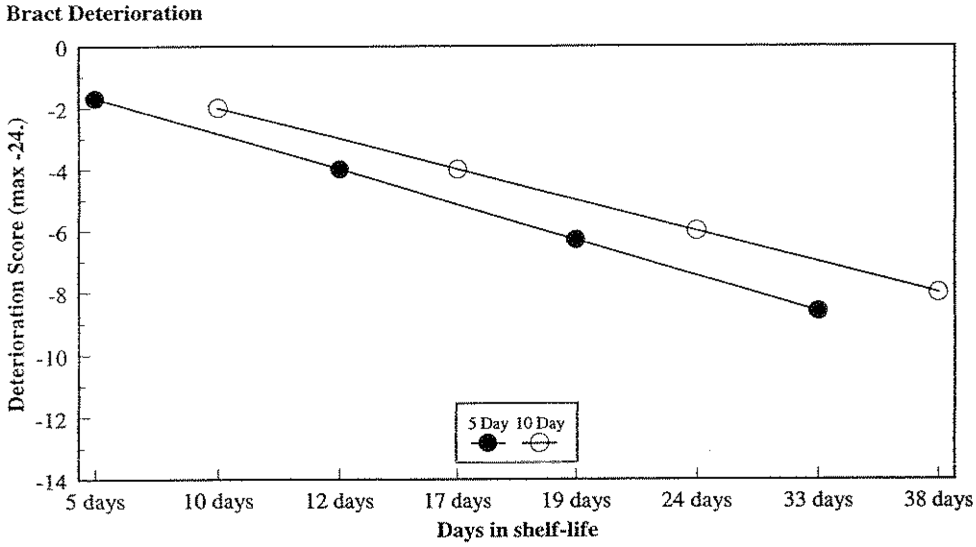
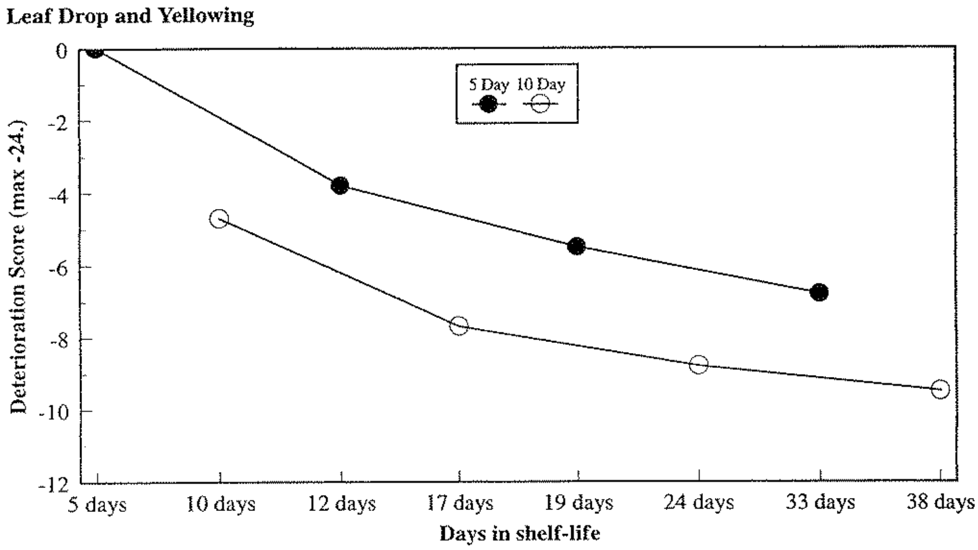
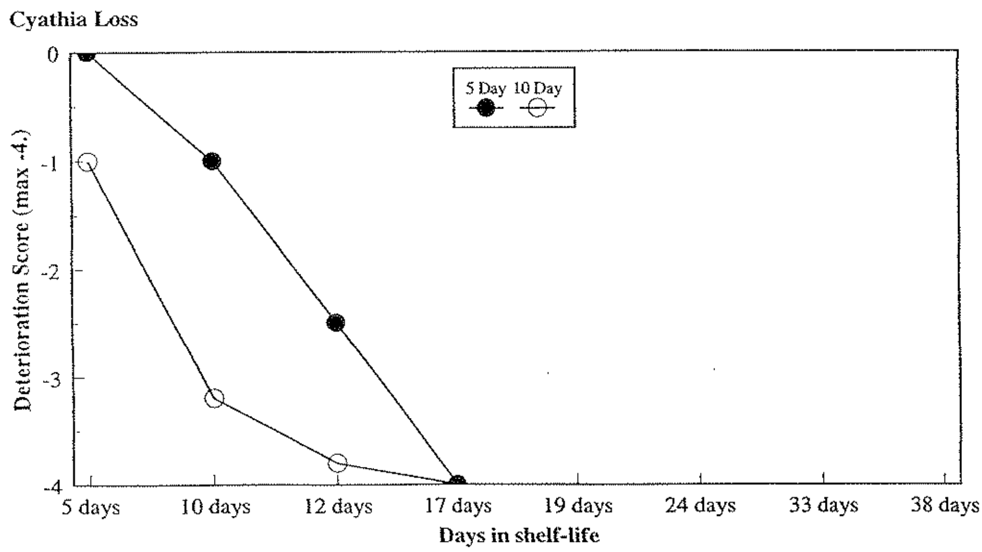


Figure 14. Effect of sleeve duration on shelf-life cv. Red Sails







APPENDIX XI Growing Media Analyses - Shelf-life

Table 26 Media analysis* on 18 January 1995

		A	A+	B	B+	C	C+
Conductivity	µs/20°C	250	219	143	337	194	183
pH		5.8	5.8	6.6	5.7	6.6	6.7
Nitrate (as N)	mg/l	114	66	44	126	81	42
Ammonium (as N)	mg/l	0.3	0.5	0.5	0.6	0.5	0.4
Potassium	mg/l	114	89	70	128	86	58
Calcium	mg/l	125	90	77	228	85	73
Magnesium	mg/l	27	28	5	25	24	28
Phosphorus	mg/l	11	22	4	31	5	10
Iron	mg/l	<0.01	<0.01	9.7	8.98	0.67	<0.01
Zinc	mg/l	0.79	0.64	0.5	0.78	0.49	0.99
Manganese	mg/l	0.04	0.06	0.03	0.19	0.01	0.04
Copper	mg/l	0.05	0.05	0.04	0.06	0.03	0.06
Boron	mg/l	0.24	0.28	0.17	0.34	<0.01	0.05
Sodium	mg/l	66	78	54	66	60	84
Chloride	mg/l	-	-	-	-	-	-
Sulphate (as S)	mg/l	19	31	20	51	14	25
Bulk density	g/ml	0.28	0.28	0.25	0.27	0.25	0.20

* water available - extractable analysis
\+ = with CRF

APPENDIX XI Growing Media Analyses - Shelf-life

Table 27 Media analysis* on 3 February 1995

		A	A+	B	B+	C	C+
Conductivity	μs/20°C	210	188	154	339	189	209
pH		6.7	7.0	6.9	6.3	7.0	7.1
Nitrate (as N)	mg/l	91	9	59	121	77	7
Ammonium (as N)	mg/l	0.4	0.8	0.5	0.7	0.5	0.7
Potassium	mg/l	98	49	76	112	71	28
Calcium	mg/l	106	82	123	273	99	110
Magnesium	mg/l	21	23	7	25	26	34
Phosphorus	mg/l	5	8	3	18	3	9
Iron	mg/l	<0.01	<0.01	10.07	2.92	<0.01	<0.01
Zinc	mg/l	0.35	0.21	0.22	0.50	0.31	0.76
Manganese	mg/l	0.02	0.02	0.04	0.05	0.01	0.05
Copper	mg/l	0.02	0.03	0.03	0.04	0.03	0.05
Boron	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	mg/l	-	-	-	-	-	-
Chloride	mg/l	-	-	-	-	-	-
Sulphate (as S)	mg/l	-	-	-	-	-	-
Bulk density	g/ml	0.23	0.21	0.31	0.27	0.26	0.17

* water available - extractable analysis
\+ = with CRF

APPENDIX XI Growing Media Analyses - Shelf-life

Table 28 Analysis* of CRF granules on 3 February 1995

		A+	B+	C+
Nitrate (as N)	g/kg	11.9	22.5	17.8
Ammonium (as N)	g/kg	30.0	29.2	34.0
Potassium	g/kg	47.2	67.7	54.0
Calcium	g/kg	28.4	20.4	26.2
Magnesium	g/kg	4.8	4.0	4.9
Phosphorus	g/kg	31.6	36.3	34.4
Sodium	g/kg	-	-	-
Sulphate (as S)	g/kg	13.1	10.0	11.5
Iron	g/kg	<1.0	<1.0	<1.0
Zinc	g/kg	4.0	2.0	5.0
Manganese	g/kg	69	56.0	66.0
Copper	g/kg	1.0	3.0	4.0
Boron	g/kg	<1.0	<1.0	<1.0

* By water - available extraction after crushing

APPENDIX XII

Table 29 **Dates to 50% colour for natural season plants and those delayed by NBL (10 days)**

	Cultivar					
	Lilo	**Freedom**	**Red Sails**	**Marlene**	**Menorca**	**Ria**
N/S	21.10	12.10	20.10	20.10	26.10	20.10
NBL	02.11	25.10	01.11	01.11	07.11	31.10

N/S = natural season crop
NBL = crop delayed using NBL until 2 October, 10 days

There was no effect of media type, nutrition or pinching date on the time until 50% colour.

APPENDIX XII

Table 30 **Mean plant height (cm) at marketing comparing N/S and NBL crop**

Cultivar	N/S	NBL
Lilo	22.3	26.2
Freedom	24.4	27.6
Red Sails	25.4	27.4
Menorca	21.6	24.6
Marlene	22.4	23.1
Ria	19.6	25.0
Mean	22.6	25.6

N/S = natural season
NBL = lit crop, delayed 10 days

Table 31 **Mean plant spread (cm) at marketing comparing N/S and NBL crop**

Cultivar	N/S	NBL
Lilo	35.0	38.6
Freedom	34.9	38.8
Red Sails	37.6	42.2
Menorca	36.9	43.4
Marlene	36.3	38.9
Ria	35.7	42.4
Mean	36.0	40.7

N/S = natural season
NBL = lit crop, delayed 10 days

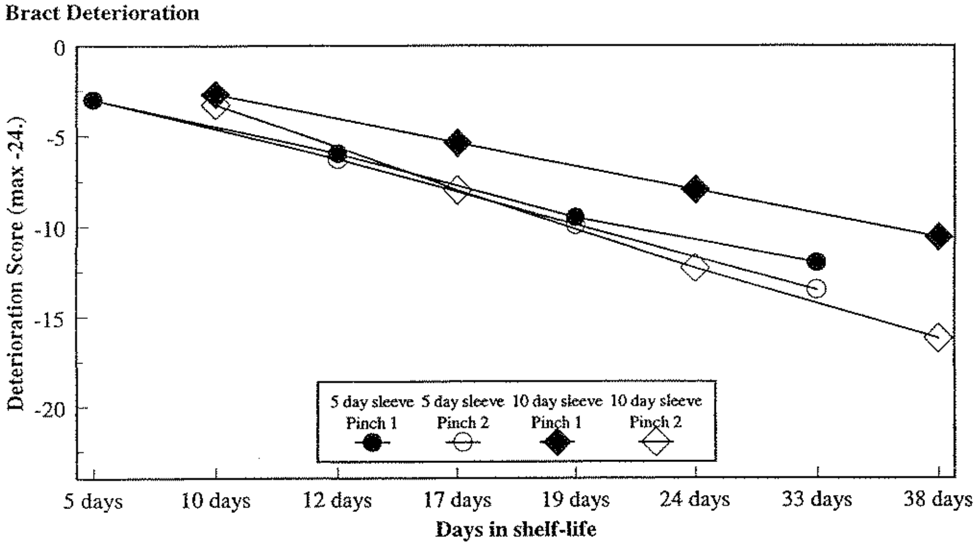
APPENDIX XII

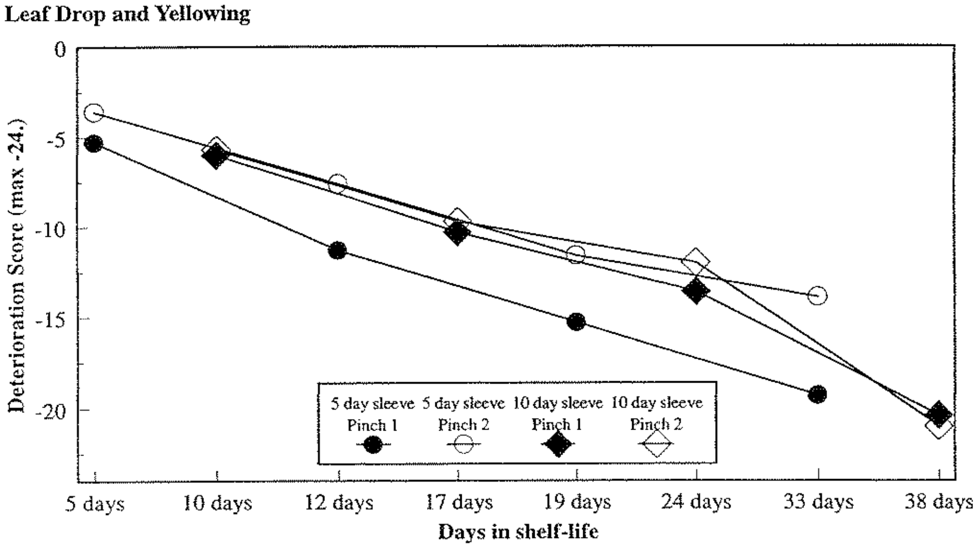
Table 32 **Mean bract size for N/S and NBL crops**

Cultivar	Treatment	Percentage of bracts in each size category Bract size (cm) > 22.5	> 20	> 15	< 15	Total No. Bracts
Lilo	N/S	21	41	23	15	5.6
	NBL	11	38	30	21	5.7
Freedom	N/S	45	30	14	11	6.4
	NBL	30	37	27	6	6.0
Red Sails	N/S	35	40	12	7	5.7
	NBL	3	32	41	24	7.1
Menorca	N/S	0	4	73	23	6.6
	NBL	0	3	43	54	6.9
Marlene	N/S	16	45	29	10	6.1
	NBL	3	22	54	19	6.8
Ria	N/S	31	38	18	13	6.1
	NBL	8	33	41	18	7.2
Mean	N/S	25	34	28	13	6.1
	NBL	10	27	39	24	6.6

N/S = natural season
NBL = night break lighting

Figure 15. Shelf-life of Red Sails - Commercial Trials





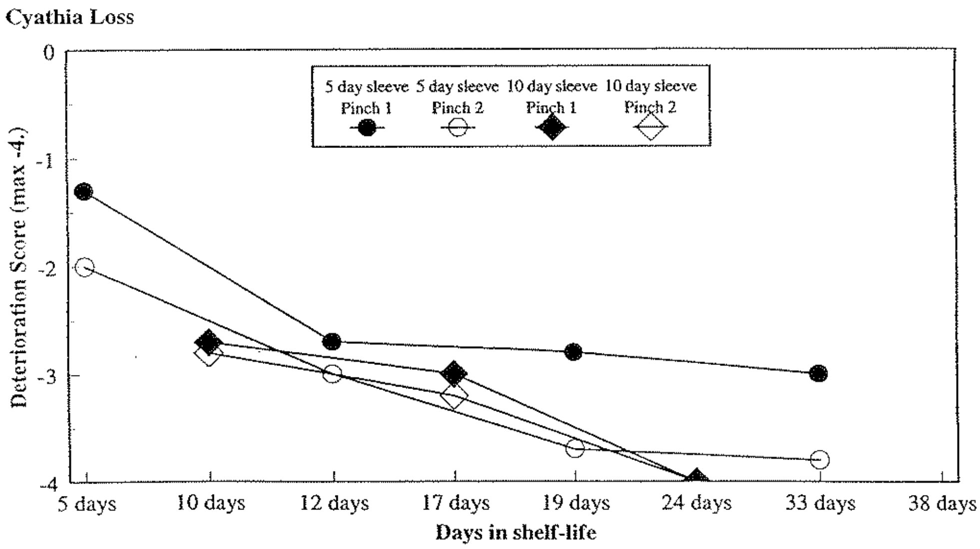
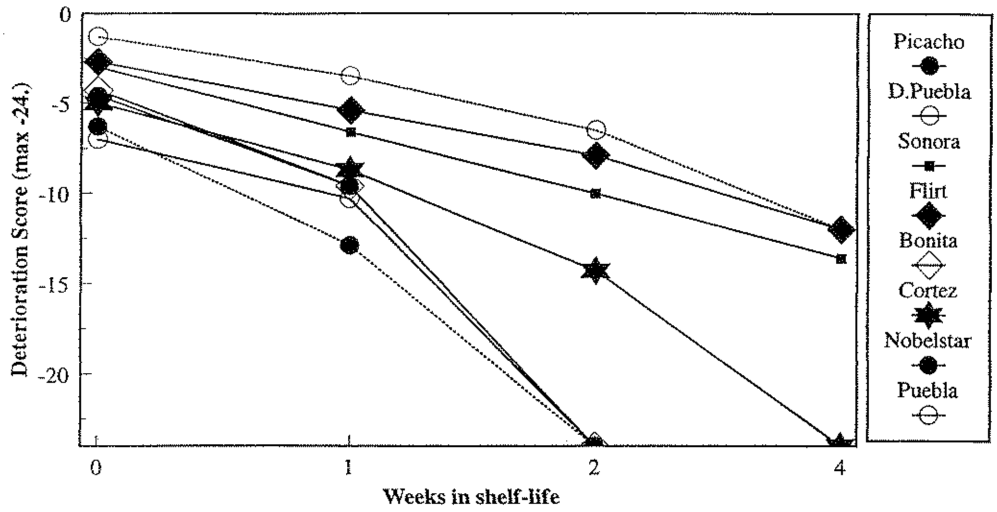
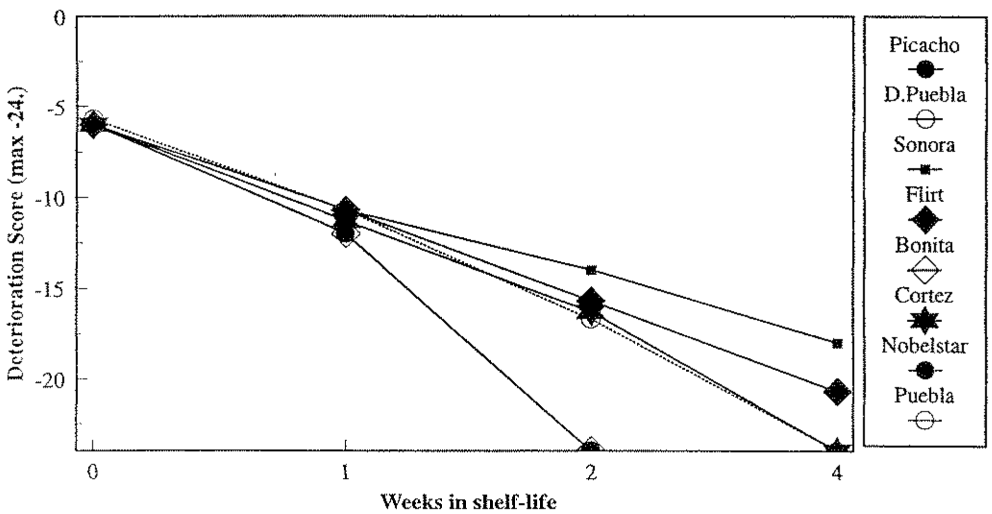


Figure 16. Shelf-life of New Cultivars - Commercial Trials

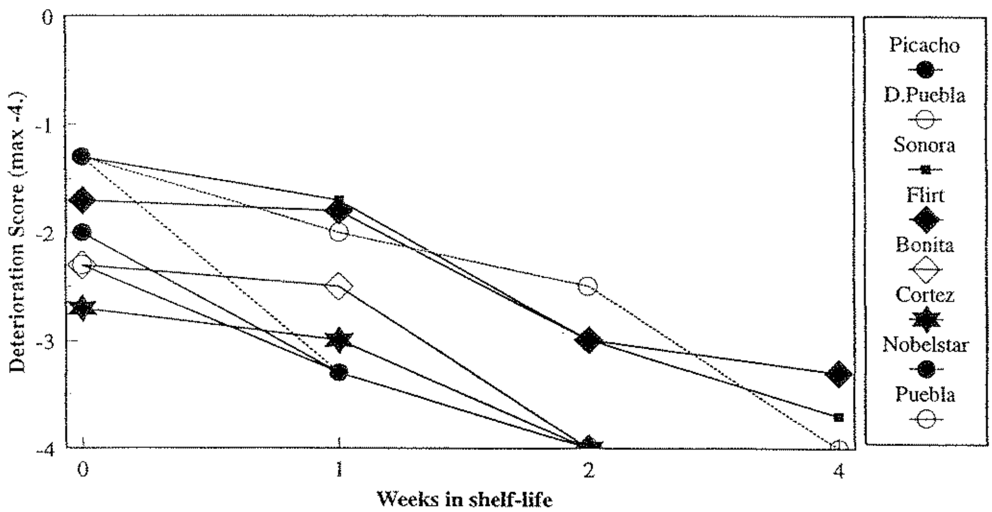
Bract Deterioration



Leaf Drop and Yellowing



Cyathia Loss

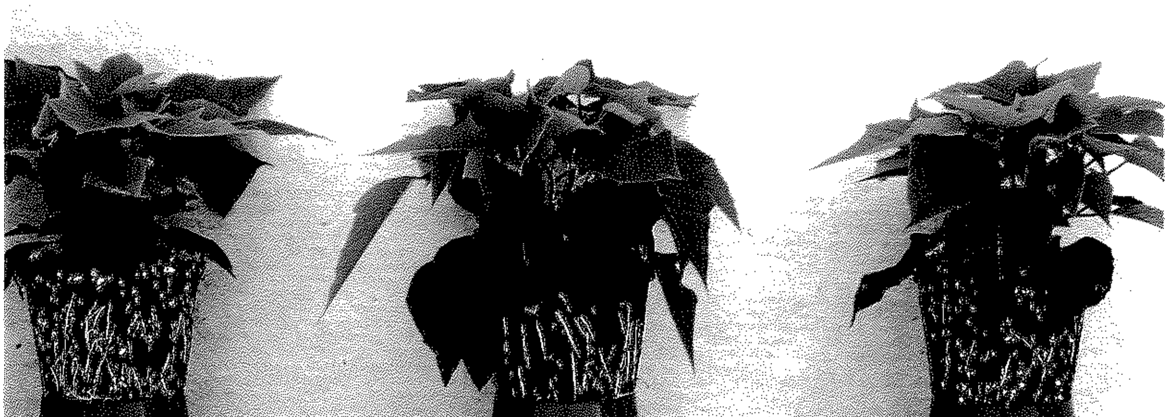


APPENDIX XIV

Plate 1 **Photograph at 4 October 1994 showing root development in each media type, from left to right A-B-C**

cv Red Sails

cv Freedom



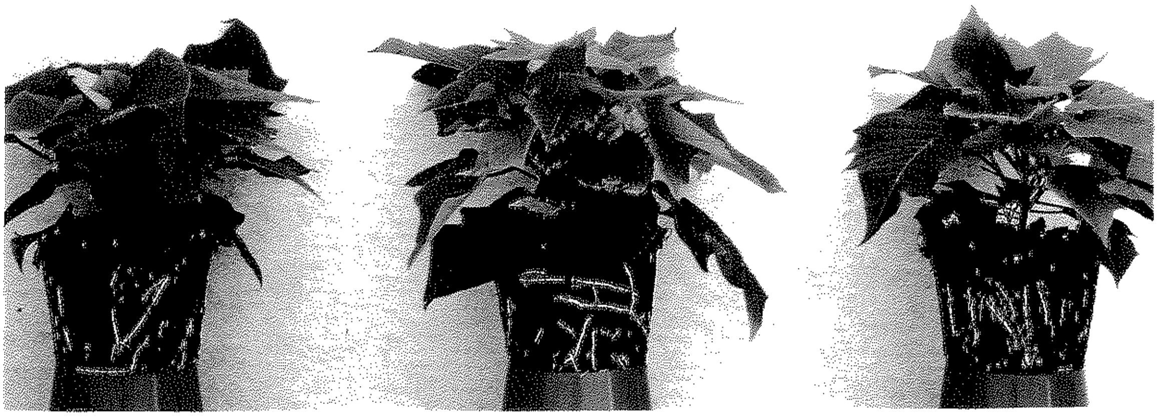
cv Lilo

APPENDIX XIV

Plate 2 **Photograph at 4 October 1994 showing root development in each media type with CRF, from left to right A-B-C**

cv Red Sails

cv Freedom

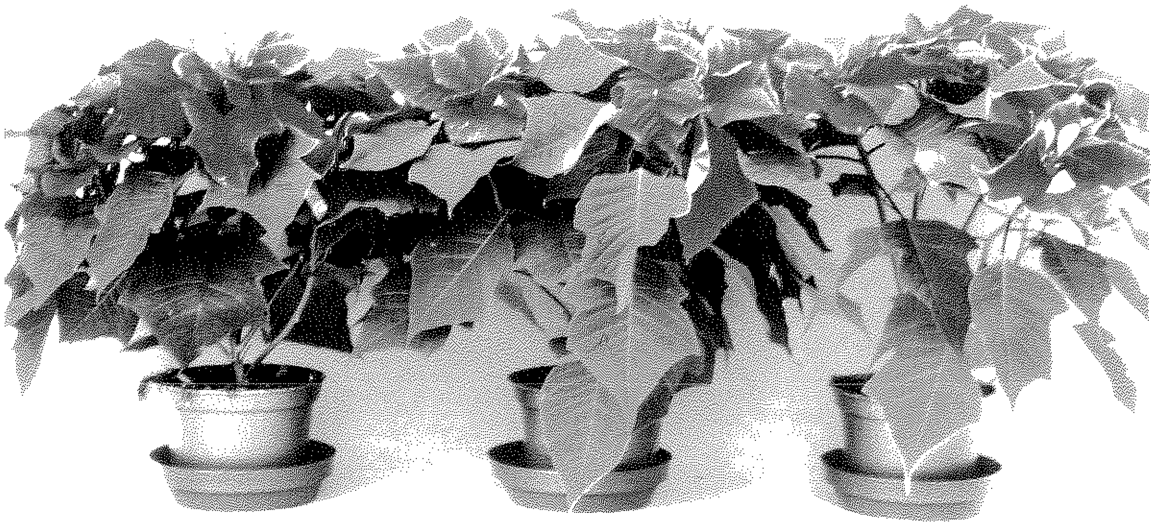


cv Lilo

APPENDIX XIV

Plate 3 **Photograph at end of shelf-life comparing media types, from left to right A-B-C**

cv Red Sails



cv Freedom

cv Lilo

APPENDIX XIV

Plate 4 **Photograph at end of shelf-life comparing media type with CRFs, from left to right A-B-C**

cv Red Sails

cv Freedom

cv Lilo

APPENDIX XIV

Plate 5A Use of Atrinal as a chemical pinching agent (right) in comparison to manual pinching (left). Photograph taken 14 days after application/pinching, cv Lilo

Plate 5B Use of Atrinal as a chemical pinching agent (right) in comparison to manual pinching (left). Photograph taken 21 days after application/pinching, cv Lilo

APPENDIX XIV

Plate 6 **Comparison of natural season (left) and NBL (right) grown plants (photograph taken 17 November 1994)**

cv Marlene

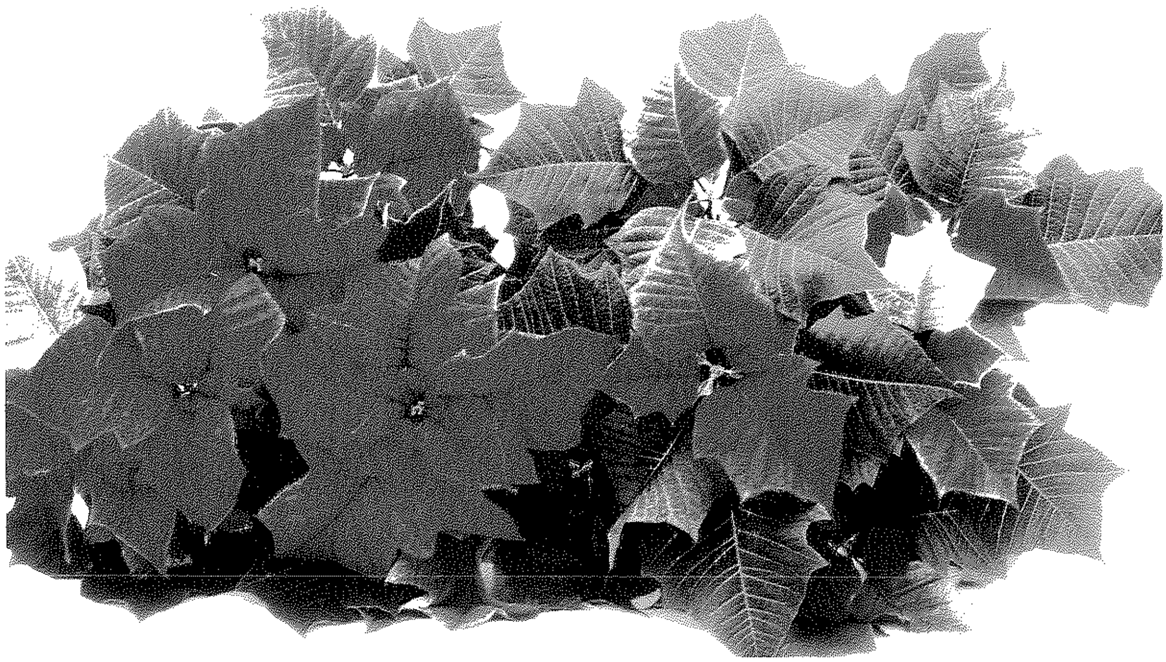
cv Ria

cv Menorca

APPENDIX XIV

Plate 7 **Comparison of natural season (left) and NBL (right) grown plants (photograph taken 17 November 1994)**

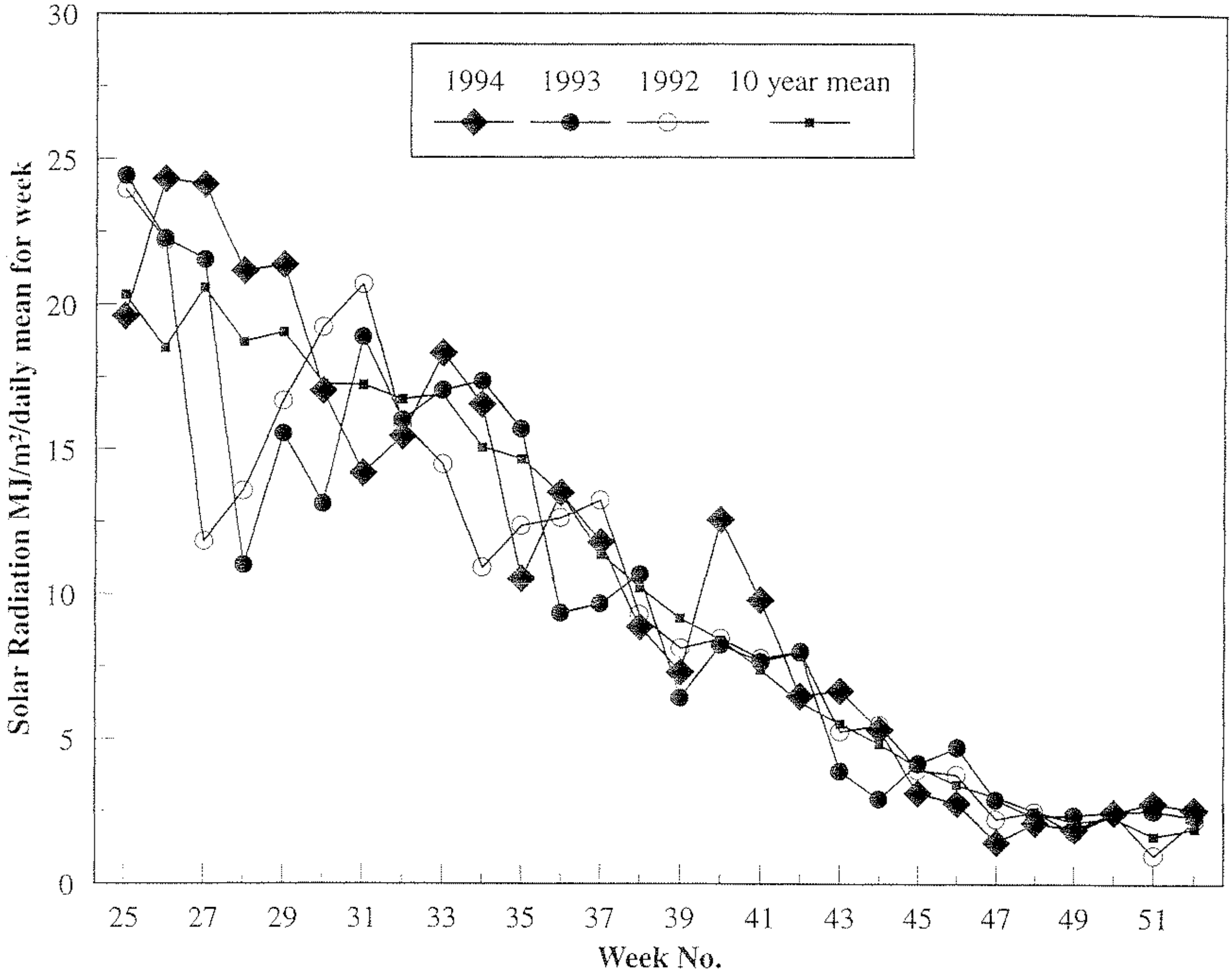
cv Red Sails



cv Freedom

cv Lilo

Solar Radiation at HRI Efford, 1994



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

1. **TITLE OF PROJECT** **Contract No: PC71b**

TO EVALUATE THE EFFECT OF PINCHING TECHNIQUE AND COMPOST TYPE ON THE GROWTH, DEVELOPMENT AND SHELF-LIFE OF POINSETTIA CULTIVARS.

2. **BACKGROUND AND COMMERCIAL OBJECTIVE**

Crop production and scheduling is important in an attempt to produce high quality plants for marketing in a continual but short period at Christmas. Both timing and method (manual or chemical) of pinching will clearly influence the growth and appearance of the final product. Previous research at HRI Efford and HRI Littlehampton has shown varietal response of initiation for natural season (NS) and the advantageous use of night break lighting (NBL) to delay crops. Further work with regard to timing of pinching in relation to floral induction will provide useful information towards cultivar response and plant growth. Effect of substrate type needs to be evaluated in conjunction with pinching dates.

As a result of recent trials at HRI Efford, Littlehampton and elsewhere, a considerable body of information has been gathered as to how components of the aerial environment specifically humidity, temperature (DIF) and lighting (NBL) may be used to manipulate the production and subsequent shelf-life performance of Poinsettia. To date, however, in the UK little attention has been given to the substrate type and nutritional supply in the production and growth of Poinsettias and in particular influence upon post harvest performance. Research in the U.S. has demonstrated that the selection of an appropriate growing medium and fertigation regime can have a marked effect on both production and shelf life of the crop. The nutritional regime adopted in relation to substrate type prior to marketing has been demonstrated to influence the incidence of plant quality disorders such as bract edge necrosis and leaf/cyathia abcision. Controlled growth and production can either be achieved with the use of a liquid feed programme or incorporation of a controlled release fertilizer (CRF) into the compost base. Research in Germany has led to the development of specific substrate types suited for Poinsettia cultivation, although few trials have been conducted in the UK in their use. There is a need to consider these new compost types in conjunction with either type of nutritional regime.

Within all sectors of ornamentals increasing emphasis is being afforded to post harvest handling and shelf-life properties of pot plants. Retailer and consumer alike are demanding high quality, long lasting plants throughout the Christmas season. It is clear substrate type and nutrition play an important role in the post production performance of the plant. Of equal importance is crop handling with respect to the use of sleeves and pre/post harvest conditioning to minimise plant quality losses.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

While difficult to quantify fully, the benefits to the industry are likely to be in several key areas. Figures quoted elsewhere (Proposal for project PC71) placed a notional value on losses due to poor quality or bract damage at between £150-170K per year. Several components of this proposed study, specifically the influence of compost type, nutrition and 'sleeve duration' on shelf-life may be instrumental in reducing this figure.

The use of chemical pinching agents if successful is likely to result in reduced labour costs.

The evaluation of novel cultivars and their patterns of initiation (subsidiary trial) are necessary for the continued success of Poinsettia in the UK market place.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

The components of this proposed study must principally aim to evaluate and quantify the effects of pinching technique and compost type on the growth, development and shelf-life of three Poinsettia cultivars. Post production handling, specifically duration in the sleeve will also be fully evaluated.

A subsidiary trial will evaluate a range of novel cultivars to determine their point of initiation and associated leaf number when grown as natural season or delayed (10 days NBL) crops.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

HRI Efford; Projects PC41, PC71 and 71a.

HRI Littlehampton; Projects PC6 and PC41.

Overseas: Continued Studies at Michigan State and Massachusetts Universities.

6. DESCRIPTION OF THE WORK

A. Main Trial

Pinching: (Option 1 <u>OR</u> 2)

Option 1: Comprising two pinching techniques, a 'conventional' manual pinch compared to the use of a chemical pinching agent.

Option 2: Two conventional pinchings at different times post potting.

Note: As little is known about the type, rate and timing of application of chemical pinching agents on Poinsettia it is suggested that a single product (Atrinal) is evaluated as an 'observation'.

Option 2 would therefore be selected for the main trial;

with two conventional pinchings post potting (this may be further expressed as an early and a late pinching in relation to the date of start of SD).

Substrate: Three composts will be evaluated within this trial; subject to further discussion these will be:

(i) The 'main' UK compost. (Shamrock - UK/Eire)
(ii) A German proprietary mix. (Stender - German)
(iii) A Dutch proprietary mix. (EGO - Dutch)

Use of Controlled Release Fertiliser (CRF) in each of (i), (ii) and (iii).

Nutrition will need to be standardised across compost types/fertigation regimes either on the basis of N-P-K levels or total cf. Either technique will call for detailed monitoring via compost and possibly leaf analysis.

Shelf-life: (Main Trial)

The use of Calcium Chloride sprays at 400 ppm applied weekly or as one application prior to marketing in 1993 was shown to have some effect in reducing the incidence of bract edge necrosis during shelf-life. This response should be further evaluated. In addition the duration for which plants are sleeved should be increased to five and ten days to reflect current commercial/retail practices.

Cultivars: Three cultivars will be evaluated within the main trial:

(i)	Eckespoint	Lilo
(ii)	Eckespoint	Red Sails
(iii)	Eckespoint	Freedom

Design and Location:

Pending further discussion with the statistician the trial is likely to take the form of an unreplicated split plot design. The substrate component will be at the compartment level enabling watering to be optimised for each compost. Each compost will be evaluated on benches (K-BLOCK comps 1, 8 and 14) and ebb and flood floors (K-Block comps 4, 5 and 10).

Pinching will be at the sub-plot level with the three cultivars as sub sub plots.

6 main plots (compost/CRF)
x
2 sub-plots (pinchings)
x
3 sub sub-plots (cultivars)

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36 sub-plots in total. (NB see shelf-life)

Each sub-plot will comprise c. 60 plants (pot thick)

Each of the initial 36 sub-plots will be further sub-divided into two; ie. with or without Calcium Chloride application. From the resultant 72 plots a total of six plants per plot will be subject to a shelf-life evaluation; half remaining sleeved for 5 days the balance for 10.

Cultural Details:

Subject to further discussions with the project co-ordinator and ADAS national pot plant consultant, all plants will be grown from cuttings stuck in week 32 in 13 cm pots with initiation delayed by 10 days (NBL). In all other respects best commercial practice will be followed throughout.

B. Subsidiary Trial

The subsidiary trial will evaluate a range of novel cultivars alongside those to be used in the Main trial (controls). The cultivars to be evaluated will occupy two compartments of K-Block being grown both as natural season (N/S) and delayed (10 days NBL) crops. These cultivars will in addition, provide material for detailed initiation assessments to be undertaken by Dr Allen Langton (HRI-L). The date of pinching may well influence the date of N/S initiation by influencing the size of the breaks at the start of inductive conditions. It would therefore be possible to impose a further pinching treatment on the newer cultivars such that plants were all pinched 'X' days before the date of the likely start of SD (taking the equinox as the start of SD for N/S plants).

Cultivars:

Lilo	Ria
Red Sails	Minorca
Freedom	Marlene

Pinching treatments:

(i) N/S induction, pinching 'X' days before equinox
(ii) NBL induction, pinching 'X' days before 2 October
(iii) NBL induction, pinching 'X' days before equinox

C. Commercial Assessments

Finished plants of the three principal cultivars from the main trial will be despatched to Efford from two commercial holdings. These plants will be subject to standard post-production conditions and their shelf-life evaluated.

Records:

(A) Main Trial

1. Full Crop diary

2. Marketing: Final growth and quality assessments to include:

- Plant height
- Plant diameter
- Number of heads
- Diameter of individual heads
- Overall quality

3. Compost analysis and AFP prior to marketing
4. P and D assessments
5. Record of physiological disorders affecting foliage and or bract development
6. Shelf-life for six weeks following a simulated transport run
    - Leaf damage: Dropped, Yellowed, Other
    - Bract damage: Bruising, Necrosis, Rabbit tracks, Other
    - Cyathia loss
7. Full photographic record

(B) Subsidiary Trial

Components 1, 2, 4, 5 and 7 from above in addition to time of initiation data as described.

(C) Commercial Assessments

Full shelf-life record as detailed in item 6 above.

7. COMMENCEMENT DATE, DURATION AND REPORTING

Start date 01.08.94; duration 9 months. Interim results will be available to HDC and visiting groups throughout the season. The experimental work will be completed by February and the full report will be submitted by 1 May 1995.

8. STAFF RESPONSIBILITIES

Andrew Fuller (Project Leader)	(HRI Efford)
David J Hand	(HRI Efford)
Allen Langton	(HRI Littlehampton)
Harry Kitchener	(ADAS, Huntingdon)
Gary Shorland (HDC Co-ordinator)	

9. LOCATION

HRI Efford, Lymington, Hants.
Two commercial holdings.

Contract No: PC71B
Date: 26.7.94

TERMS AND CONDITIONS

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

Signed for the Contractor(s)

Signature..

Position.. Commercial and Marketing Manager HMI

Date.......... 8/8/94 ....

Signed for the Contractor(s)

Signature..

Position..

Date..

Signed for the Council

Signature..

Position.... CHIEF EXECUTIVE ....

Date.......... 26.7.94 ....