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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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Appendices

1. PRACTICAL SECTION FOR GROWERS

1.1 OBJECTIVES AND BACKGROUND

Many growers in Germany appear to be cultivating poinsettias at temperatures below those typically used commercially in the UK. The heating set point is generally 15°C throughout production, but in some cases this is lowered to 12°C during the final weeks of production. A slightly earlier potting appears to be required to achieve success with this lower temperature regime. The potential benefits of a cooler growing regime are savings in heating costs and reductions in use of plant growth regulators. It is also possible that plant quality is improved, both at the point of sale where a 'harder' plant might be more able to withstand the handling involved, and also in shelf/home life.

A cooler growing trial was, therefore, commissioned by the HDC at HRI Efford in 1995. Ten cultivars were selected and plants were potted from week 28 to week 32. Since lower temperatures give a reduced rate of plant development, the cool crops were potted in weeks 28 and 30, whilst control 'warm' crops were potted in weeks 30 and 32. Cool-grown plants were grown with a heating set point of 15°C throughout production, with venting set at 1 - 2°C higher. In all other respects, plants were grown as per normal commercial practice. The results of this trial were presented in PC 71c, First Year Report, Fuller 1996.

The results from this first year of work clearly demonstrated the potential benefits of cooler growing regimes. However, the 1995 poinsettia season was exceptionally good, with high light levels throughout the summer and well into the autumn period. It was uncertain, therefore, whether the results would be applicable to a more typical (poorer light) year. The decision was therefore taken to re-evaluate cooler growing in 1996, and the findings are reported here, together with a comparison of the two years. Cool-grown 13 cm pots were potted in weeks 28 and 30, whilst control commercial pots were potted in week 31, and the cultivars were restricted to four. To ensure lower light levels in 1996 than in 1995 (to simulate a 'poorer' year or more northerly locations), a shading treatment was introduced. The second year of work was also extended to include spacing treatments, since closer spacing would increase production per unit area and, therefore, returns. Finally, the comparison of cool and warm growing was extended to 10 cm pots with potting weeks of 34 and 35 for the cool crops, and week 35 for the warm.

Red cultivars constitute around 70% of poinsettias grown in the UK and the range of cultivars has remained fairly stable over the last few years. However, these cultivars can be prone to problems in production: Lilo, with erratic breaking; Red Sails, uneven habit; Freedom, poor cyathia; Ria, a reputation for poor shelf-life. In 1994, it was evident that a large number of new cultivars were being grown in continental Europe, and many were seen to have potential

for production in the UK. Thus, in 1995, plant propagators and young plant suppliers were invited to submit material for an independent evaluation of new cultivars at HRI Efford. In total 26 cultivars were supplied and these were grown under standard commercial conditions at HRI Efford and evaluated at marketing. In addition, a limited number of these new cultivars were also selected for trial on four commercial nurseries. Plants from all trials were subjected to a shelf-life test for a period of six weeks at Efford, and the results of these growing and shelf-life trials were presented in PC 71c, First Year Report, Fuller 1996.

Assessment of new cultivars was continued in the second year of the project (1996) on commercial nurseries only. Interim and marketing records were collected on four commercial sites, and this was followed by shelf-life testing within the controlled facilities at HRI Efford. The results of these trials are reported here.

1.2 SUMMARY AND DISCUSSION

The 1995 trial showed, using a 0 (worst) - 2 (best) scale, that overall plant quality at marketing was comparable in the cool-grown crops (scores of 1.39 and 1.45 for weeks 28 and 30 respectively) to that of the control week 30 crop (1.44), but less good than the week 32 warm crop (1.78) (Table 1). Height specifications were reached in both cool crops but, of these, that potted in week 28 was judged the best since it had more 'bulk'. Bract star size tended to be smaller in the cool-grown crops, and these also tended to show a little more unevenness at marketing. There were no obvious differences in shelf life due to growing temperature, and no increased incidence of *Botrytis* stemming from the higher relative humidities which accompany cooler temperatures.

Table 1. Average Plant Quality Scores in Year 1 (0 = poor; 2 = best)

		Cool-Grown		Warm-Grown	
Cultivar	**Mean**	**Week 28**	**Week 30**	**Week 30**	**Week 32**
Cortez	1.80	1.65	1.80	1.80	1.95
Freedom	1.61	1.60	1.25	1.60	2.00
Liberty Red	1.44	1.45	1.30	1.35	1.65
Maren	1.64	1.35	1.65	1.60	1.95
Menorca	1.36	1.25	1.40	1.20	1.60
Dark Puebla	1.26	1.15	1.15	1.45	1.30
Red Sails	1.42	1.25	1.40	1.30	1.75
Red Splendour	1.40	1.15	1.20	1.40	1.85
Sonora	1.62	1.40	1.50	1.75	1.85
Spotlight	1.60	1.65	1.85	0.95	1.95
Mean	1.52	1.39	1.45	1.44	1.78

The cultivars judged to be most suitable for early-potted, cool growing in the 1995 trials were Freedom, Liberty Red, Cortez, Sonora, Red Sails, Menorca and Maren. Bract star size was judged to be too small in Spotlight and Red Splendour, and Dark Puebla was very late to reach maturity.

The 1996 trials confirmed that cooler growing has to be accompanied by 2-3 weeks earlier potting. Thus the one week of additional growing which the week 30 cool pots (13 cm) were given was insufficient to compensate for lower temperature, and plant size and overall plant quality was markedly reduced, especially in Freedom and Sonora. Similarly, the one-week earlier potting of cool plants in the 10 cm trial resulted in greatly reduced quality. However, given three weeks earlier potting (week 28), cool-grown 13 cm plants were, as in 1995, essentially of as high a quality as control plants (Table 2). Although plants were generally rather short in 1996, week 28 cool-grown plants were at least as tall as the controls, and all except Red Sails were of comparable plant diameter. Cool temperature had no adverse effect on bract star number, but bract size was reduced in Ria and Sonora, as found in 1995. Cool growing tended to accelerate bract colouring and cyathia development.

Table 2. Average Plant Quality Score in Year 2

	Quality Score			
	Ambient Light		Shaded	
Cultivar/Regime	**10 plants/m^2**	**12 plants/m^2**	**10 plants/m^2**	**12 plants/m^2**
Freedom				
Week 28 cool	2.25	2.50	1.75	1.88
Week 30 cool	1.13	1.50	0.94	1.00
Week 31 warm	2.63	2.50	2.50	2.63
Ria				
Week 28 cool	2.38	2.63	2.38	1.75
Week 30 cool	1.63	1.38	1.63	1.38
Week 31 warm	2.38	1.38	1.38	1.00
Sonora				
Week 28 cool	1.50	1.63	1.63	1.13
Week 30 cool	1.13	1.00	1.13	1.13
Week 31 cool	2.00	1.63	1.75	1.38
Red Sails				
Week 28 cool	2.88	3.00		
Week 30 cool	2.88	1.38		
Week 31 cool	3.00	2.88		

Closer spacing had no deleterious effects either on the height or the diameter of week 28 cool-grown plants, but tended to reduce bract star size in cultivar Ria. Overall, average plant quality was judged to have been as good at the higher spacing as at the lower spacing, except for Ria grown shaded. Thus, there would appear to be considerable scope for increasing plant densities and throughput per unit area. However, this conclusion must be viewed with caution since greater vigour might have resulted in greater plant competition and an adverse effect of closer spacing on quality.

The light climate in 1996 was similar to that in 1995, so extrapolations of the findings to more northerly locations is best done by considering the effects of shading. Shading slightly reduced plant height and diameter in week 28 cool-grown Ria, but not in Freedom or Sonora (Red Sails was not grown in a shaded treatment). It did, however, cause a larger and more general reduction in bract star size. Overall, mean plant quality tended to be reduced by shading in all three cultivars, with the effect being most marked in Ria grown at high density. Thus, it seems likely that cool growing would require a rather longer compensatory period of growth (prior to normal 'warm' potting date) for the practice to be successful in northerly parts of Britain. As in 1995, higher relative humidities accompanying lower temperatures did not noticeably increase the incidence of *Botrytis*.

Cool growing had no adverse effect on shelf life in 1995, but gave mixed results in 1996. Thus, overall performance was improved by prior cool-growing in Ria, but was reduced in Sonora and Red Sails, by encouraging earlier leaf and bract drop and accelerating colour fading. It is not clear why results should differ between years and between cultivars. Commercially cool-grown plants of Red Sails also showed greater leaf and bract loss during shelf life. Sleeving, both in the Efford trials and in commercially grown Red Sails, had little obvious effect on shelf life in general, although it did appear to increase early leaf loss of cool-grown Freedom plants.

Given that cool growing (with earlier potting date) can give commercially acceptable poinsettias, the question remains as to potential benefits. The most obvious benefit of cool growing, so long as the requirement for a longer crop time fits in with the annual cropping cycle, is reduced energy use. This was calculated in the Year 1 Report using the computer program, Horticern, and the savings (in an average year) were expressed in terms of litres/m^2 heating oil equivalent for a glasshouse of the size and type used in the Efford trials. This exercise was repeated in 1996, but based on expectations for a large, modern (0.25 hectare) block sited either in the south of England (Lymington) or the north of England (Boston). Although the energy inputs required to maintain the two growing regimes were higher for the northern site, the potential savings due to cool growing proved almost identical. Thus, cool growing can be expected to save the equivalent of about 7 litres/m^2 oil where screens are not used, and about 6 litres/m^2 oil where screens are used. These figures are rather smaller than

those calculated in the Year One Report since these latter were based on the use of a much smaller glasshouse. Growing in a commercial glasshouse smaller than 0.25 hectares can be expected to give greater savings (but actual costs will be higher).

The second potential benefit of cool growing is a reduction in total cycocel used to regulate growth, and in numbers of cycocel applications. Earlier potting is necessary to achieve comparable quality so the appropriate comparisons of use in Year 1 were between the week 28 cool crop and the week 30 warm crop, where the saving due to lower temperature was 9%, and between the week 30 cool crop and the week 32 warm crop, where the saving was 45%. Crops tended to be rather less vigorous in 1996, and overall growth regulator application was reduced to below that in 1995 by 39%. Presumably as a result of this, cooler cropping in 1996 did not give a saving in growth regulator use. Averaging over cultivars, a one-week earlier potting for cool-grown pots gave no reduction, and a 3-week earlier potting actually increased the total applied by 10%. Of the four cultivars grown in 1996, Freedom was the only one where cooler growing allied to three weeks earlier potting, reduced cycocel use (by 7%) and the only one showing substantial savings in growth regulator use when potting was just one week earlier (20%). The number of cycocel applications needed to control growth in the week 28 cool crop was also increased by up to 3, depending on cultivar, so there was no benefit from reduced labour inputs.

A major feature of the first year of the project was a comparison of 26 new cultivars grown at Efford under standard commercial conditions, and 11 new cultivars grown on four commercial nurseries. All cultivars grown at Efford and cultivar samples from two of the commercial sites were subsequently evaluated for shelf life at Efford. Full details of the performance of the new cultivars are given in the Year 1 Report, but cultivars singled out as being of particularly high quality at marketing were Eda Rose and Noblestar. Best quality scores in shelf life were assigned to Spotlight Crimson, Success, Lilo Marble and Dynasty Red. New cultivar evaluations in 1996 were confined to 10 (including controls) grown on four commercial nurseries, and descriptions and performance of these are recorded in this Report.

2. EXPERIMENTAL SECTION

2.1 INTRODUCTION

It was apparent on a grower visit to Germany in 1994 that many growers there were cultivating poinsettias at temperatures below those typically used commercially in the UK. The heating set point was generally 15°C throughout production, but in some cases this was lowered to 12°C during the final weeks of production. A slightly earlier potting appeared to be required to achieve success with this lower temperature regime. Adoption of cooler growing in the UK was thought to have the potential to give large savings in heating costs, allied with possible reductions in use of plant growth regulators (PGRs). It was also thought that plant quality might be improved, both at the point of sale where a 'harder' plant would be more able to withstand the handling involved, and also in shelf/home life.

A cooler growing trial was, therefore, commissioned by the HDC at HRI Efford in 1995. Ten cultivars were selected and plants were potted from week 28 to week 32. Since lower temperatures give a reduced rate of plant development, the cool crops were potted in weeks 28 and 30, whilst control 'warm' crops were potted in weeks 30 and 32. Cool-grown plants were grown with a heating set point of 15°C throughout production, with venting set at 1 - 2°C higher. In all other respects, plants were grown as per normal commercial practice. An opportunity was given to growers to view these trials at Efford at the end of November, and again during early February to see the results of the shelf-life test, and the results were presented in PC 71c, First Year Report, Fuller 1996.

The results from this first year of work clearly demonstrated the potential benefits of cooler growing regimes. Cultivars considered most suitable for cooler growing included Freedom, Red Sails, Liberty Red, Menorca and Cortez. These all reached a marketable stage for the Christmas market. Furthermore, an energy saving of about 40% in heating costs was calculated for the cooler regime, along with a saving of up to 70% in Cycocel applications. However, the 1995 poinsettia season was exceptionally good, with high light levels throughout the summer and well into the autumn period. It was uncertain, therefore, whether the results would be applicable to a more typical (poorer) year. The decision was therefore taken to re-evaluate cooler growing in 1996, and the findings are reported here, together with a comparison of the two years. To ensure lower light levels in 1996 than in 1995 (to simulate a 'poorer' year or more northerly locations), a shading treatment was introduced. The second year of work was also extended to include spacing treatments, since closer spacing would increase production per unit area and, therefore, returns. It was also thought possible that closer spacing would suit the less vigorous type of growth associated with cooler growing. It could not be ruled out, however, that cooler growing would reduce the leaf quality of the lower leaves, so that closer spacing would increase leaf drop during shelf life.

Red cultivars constitute around 70% of poinsettias grown in the UK and the range of cultivars has remained fairly stable over the last few years. However, these cultivars can be prone to problems in production: Lilo, with erratic breaking; Red Sails, uneven habit; Freedom, poor cyathia; Ria, a reputation for poor shelf-life. In 1994, it was evident that a large number of new cultivars were being grown in continental Europe, and many were seen to have potential for production in the UK. Thus, in 1995, plant propagators and young plant suppliers were invited to submit material for an independent evaluation of new cultivars at HRI Efford. In total 26 cultivars were supplied and these were grown under standard commercial conditions at HRI Efford and evaluated at marketing. In addition, a limited number of these new cultivars were also selected for trial on four commercial nurseries. Plants from all trials were subjected to a shelf-life test for a period of six weeks at Efford, and the results of these growing and shelf-life trials were presented in PC 71c, First Year Report, Fuller 1996.

Assessment of new cultivars was continued in the second year of the project (1996) on commercial nurseries only. Interim and marketing records were collected on four commercial sites, and this was followed by shelf-life testing within the controlled facilities at HRI Efford. The results of these trials are reported here.

2.2 OBJECTIVES (Year Two)

- To investigate the use of cooler temperatures for the production of poinsettias which would potentially produce savings in energy costs and reduce the reliance on and use of chemical plant growth regulators.

- To investigate the potential for manipulation of plant spacings to achieve higher plant densities and thus greater economic returns per unit area.

- To assess the effect of reduced light receipt by the crop on subsequent plant growth and development, specifically with regard to growing poinsettias at cooler temperatures.

- To examine a range of cultivars and evaluate the potential for commercial production as both 13 cm and 10 cm pot plants.

- To assess the effect of different handling and marketing procedures on the longevity of poinsettias in both shelf-life and 'home-life'.

- To continue to evaluate a range of new poinsettia cultivars for production in the UK and their performance in shelf-life.

2.3 MATERIAL AND METHODS (Year 2)

2.3.1 Site

Cool and warm temperature regimes for 13cm pot plants (main trial) were assessed in Q-Block at Efford, whilst trials relating to 10cm pots were carried out in H-Block (subsidiary trial).

2.3.2 Poinsettia Cultivars

Cuttings were kindly supplied by Young Plants Ltd, W.J. Findons and Hollyacre Plants Ltd:

13cm pots - potted in weeks 28, 30 and 31: Freedom, Ria, Sonora and Red Sails
10cm pots - potted in weeks 34 and 35: Red Splendour, Sonora, Cortez, Ria and Freedom

2.3.3 Treatments

Temperature treatments consisted of a 'warm' (control) regime with set point temperatures as currently used commercially (see Section 2.3.5), and a 'cool' regime with a heating set point of 15°C day and night, and a vent set point of 17°C.

Potting dates were staggered to reflect expected differences due to temperature in plant vigour (see Year 1 results). For the 13cm pots, cool regime treatments were potted in weeks 28 and 30, whilst control regime treatments were potted in week 31. For the 10 cm pots, cool regime treatments were potted in weeks 34 and 35, whilst control regime treatments were potted in week 35.

Two final plant spacings were compared within each of the temperature regimes. For 13 cm pots, these were a 'standard' or 'commercial' spacing of 10 plants / m^2 and a close spacing of 12 plants / m^2. For the 10 cm pots, a standard final spacing of 22 plants / m^2 was compared with a close spacing of 26 plants / m^2.

Two light levels were also compared for each of the temperature x spacing treatments for 13 cm pots only. Ambient incident solar radiation, representing south coast light levels, was compared with a shaded treatment. Plants were shaded with fleece to give a 25-30% reduction in the light received. This treatment was designed to represent light levels likely to be received in a poorer year or further north in the UK. Plant layout is shown in Appendix I.

2.3.4 Experimental Design

13cm pots	2	light levels (ambient and shaded)
	x	
	3	potting dates / temperatures (weeks 28 & 30 'cool' and week 31 'warm')
	x	
	2	spacings (10 and 12 plants / m^2)
	x	
	3	cultivars (plus Red Sails grown only at ambient light)
	x	
	2	replicates
10cm pots*	3	potting dates / temperatures (weeks 34& 35 'cool' and week 35 'warm')
	x	
	2	spacings (22 and 26 plants / m^2)
	x	
	5	cultivars
	x	
	2	replicates

*grown in ambient light only

2.3.5 Cultural Techniques

All plants were potted into 13cm or 10cm pots using a proprietary peat-based growing medium (Bulrush Poinsettia mix)

All plants were watered in using plain water, and were fleeced (using 'agryl') immediately after potting. This remained in place for 10-14 days to maintain humidity around the plants. In addition, overhead shade screens were set to shade at a threshold at 300W/m^2 (outside, total) for the first two weeks, at 400W/m^2 for the next 4 weeks, and subsequently at 550 W/m^2.

Plants were pinched approximately 7-10 days after potting (when roots were seen to have explored the growing media and to have reached the pot sides). Plants in 13 cm pots were pinched to 5-6 leaves to achieve 5 good breaks, whilst those in 10 cm pots were pinched to 4-5 leaves to achieve 4 breaks. All plants were grown as a natural season crop. The market specification aim was for 4-5 good sized, well coloured bract stars, and a plant height within the range 28-35 cm (from base to top of plant canopy) for 13cm pots and 18-22 cm for 10cm

pots.

Cycocel (46% a.i.) at 1ml / litre plus spreader was applied as determined by graphical tracking to regulate growth (see Appendix II). First applications were made when a third of the plants in a treatment had breaks of 1cm in length. Repeated applications were made, up to 3 to 4 times per week, according to cultivar.

Plants were kept pot thick for the first 2-4 weeks, until they were seen to have broken well. They were then spaced as necessary, via an intermediate 30 plants / m^2, to their final density.

After an initial watering in with plain water, subsequent waterings (for the first 1-2 weeks) applied calcium nitrate to provide 150ppm N. An early season 225:25:150 N:P:K feed, with calcium nitrate provided from a separate tankfeed, was applied 3-4 weeks after potting. In short days the feed was switched to provide a higher potassium ratio: 200N:50P:200K:30Mg (Table 3). Near to marketing, liquid feeding was reduced, ie. plants were fed once per 7-10 days, and the final watering was with plain water.

Table 3. Applied Liquid Feeds

Product	First feed g/l	Early season g/l	Final feed g/l
Mono Ammonium Phosphate	-	14.10	38.00
Potassium Nitrate	-	59.21	104.00
Calcium Nitrate	145.16	156.77	-
Magnesium Sulphate	-	-	16.00
Ammonium Nitrate	-	-	62.00

First feed applied at conductivity 0.9mS plus background (dilution 1:150)
Early season feed applied at conductivity 1.6mS plus background (dilution 1:150)
Final feed applied at conductivity 1.5mS plus background (dilution 1:200)
pH of applied water was corrected to 6.0 using nitric acid

Control plants were grown in compartment Q2 where heating and venting set points were adjusted in line with current commercial practice:

Week 31 Control Plants

Timing	Set point temperature	
	Heating	Venting
Week 31 (potting)	20°C	22° C
Week 37 (temperatures gradually lowered for the start of short days)		
to 11/9/96	19° C	21° C
to 13/9/96	18° C	20° C
Week 38 (temperatures raised to counteract stunting following Basilex drench)		
	19° C	21° C
Week 39 (temperatures lowered post Basilex drench)		
	15° C	17° C

Cool treatment 13cm plants (both potting dates) were grown in compartment Q1 (with transfers from Q2 above to facilitate establishment under higher temperature as necessary).

Week 28 Cool Grown Plants

Timing	Set point temperature	
	Heating	Venting
Week 28 (potting)	20° C	22° C
Week 30/31 (temperatures gradually lowered to achieve treatments)		
to 25/7/96	19° C	21° C
to 26/7/96	18° C	20° C
to 29/7/96	17° C	19° C
to 30/7/96	16° C	18° C
to 31/7/96	15° C	17° C
Week 38 (temperatures raised to counteract stunting following Basilex drench)		
	16° C	18° C
Week 39 (temperatures lowered post Basilex drench)		
	15° C	17° C

Week 30 Cool Grown Plants

Timing	Set point temperature	
	Heating	Venting
Week 30 (potting)	20° C	22° C
Week 33/34 (transferred to cool treatment)	15° C	17° C
Week 38 (temperatures raised to counteract stunting following Basilex drench)	16° C	18° C
Week 39 (temperatures lowered post Basilex drench)	15° C	17° C

2.3.6 Shelf-Life

To examine the impact of growing regime, light level and spacing on shelf-life, 13cm plants from the week 28 cool regime and from the week 31 warm regime were assessed in a simulated shelf-life environment. Two sleeving treatments were incorporated into these shelf-life evaluations. That is, plants were either placed directly into shelf-life without sleeving, or they were sleeved for three days at the start of shelf-life.

A more extensive assessment of the impact of length of time within sleeves on subsequent shelf-life was also carried out on plants supplied by a commercial nursery. Plants of the cultivar Red Sails were grown in either a cool or warm regime at the commercial nursery. At marketing, these plants were sleeved for 0, 1, 3 or 6 days prior to commencing shelf-life evaluations.

The shelf-life assessment consisted of the following procedures:

- 0 day sleeved plants were placed directly into the shelf-life environment (detailed below) without sleeving.
- 1, 3 and 6 day sleeved plants were sleeved and boxed and transported for 3 to 4 hours in an uncontrolled environment. Following this transport period they were held for 1, 3 or 6 days in an unlit controlled environment room set at 16° C and 80% RH.
- After the sleeving period, plants were placed unsleeved in a lit environment (1000 lux

given by fluorescent strip lighting) for 12 hours per day, and held at 20°C and 60% RH. Plants remained in this environment over the six week assessment period.

2.3.7 Experimental Records:

At potting
- Record of cutting material quality and delivery (written notes).

At 4 weeks after potting
- No. of breaks and their habit (8 plants per plot)

At weekly intervals
- Plant height from pot rim to top of canopy (8 plants per plot) for graphical tracking.

At Marketing: (8 plants per plot)

- Plant height (from pot rim to top of bract - unsleeved plant)
- Plant diameter (across widest width)
- Number of shoots/breaks on each plant
- Number of bract stars on each plant and measurement of the maximum width of each star
- Cyathia score (0 = none, 1 = some, 3 = moderate and 5 = many prominent)
- Overall plant quality (0 = umarketable, 1 = second grade and 3 = grade 1 plant)
- Date of first colour per plant (per plant in plot)
- Date of first visible cyathia (per plant in plot)
- Date of marketing records (plot)
- Bract colour/disorders (written notes)
- Foliage colour (written notes)

Medium Analyses:
- At potting
- Every 2 weeks from potting for each temperature regime / potting date

Applied Liquid Feed Analyses:
- Every 2 weeks from start of liquid feeding

Plant Growth Regulation:
- Total No. applications per plot/variety
- Timing of applications

In Shelf-life: Six plants per plot were recorded at marketing so to have a record of overall plant quality before entering shelf-life, and these were subsequently recorded after 1, 3, 6, 13, 20,

27, 34 and 41 days in shelf-life.

- Number of green leaves dropped
- Number of coloured leaves or bracts dropped
- Cyathia loss (0 = none, 1 = slight, 3 = moderate and 5 = complete loss)
- Mechanical damage (0 = none, 1 = slight, 3 = moderate and 5 = severe)
- Leaf colour score (0 = good dark colour, 1 = slight paling, 3 = moderate paling and 5 = severe yellowing)
- Bract colour & deterioration (0 = no damage / colour loss, 1 = slight loss of colour, 3 = bracts paling and marked, and 5 = severe bract damage)
- Overall plant longevity score (from the above scores, low score = good shelf-life and high score = poor shelf-life)

2.3.8 Environmental Records:

Weekly records were taken of day and night temperatures and relative humidity levels in compartments Q1, Q2, H-South and H-North. External climate records included temperatures and light levels. In addition, temperature and humidity was monitored in the shelf-life rooms.

Appendix III shows that light receipt during the poinsettia growing season in 1996 was, overall, as good or better than that in 1995. Light receipt was lower than in 1995 during weeks 31 and 32, during the establishment of the control warm crop (main trial) but was the same or slightly higher in all but two of the following 13 weeks. Appendix III also shows that cool-grown crops were consistently 2 - 3°C below control 'warm' crops, on an average 24-hour temperature basis, with the differential in temperature being slightly greater during the night than during the day. Relative humidity was consistently higher in the cool regime, reaching a night time average of 85 - 87% during the later stages of the trial, compared to 75 - 80% for the control. Daytime averages were about 10% lower during these latter weeks. The shading treatment gave a reduction in weekly light integral of about 10 - 20 MJ/m^2/week (35 - 45 %).

2.3.9 Energy Use Calculations:

The computer program Horticern was used to calculate theoretical energy savings from cool growing based on long-term average weather records for Lymington (S Coast) and Boston, Lincolnshire. It was assumed that the glasshouse in which the poinsettias were grown was a 0.25 hectare square block, with five 10m bays running north/south. The ridge height was taken to be 6m and wall height to be 4m. Calculations were done with and without a thermal screen fitted. The screen was assumed to be 50% aluminised and 50% polyester (LS15 type), and fitted horizontally, 3.5m above the ground. The glasshouse was assumed to have 'good' air-tightness and to have no daytime wall cladding. The crop comparison was for a week 28

potted cool crop (day/night temperature set point of 15°C with venting 1°C above this) and a week 31 potted warm crop (day set point of 20°C, night set point of 18°C, and venting at 22°C), and it was assumed that both were marketed in week 50. Energy consumption per crop, together with savings due to cool growing, calculated both as total energy (MJ/m^2) and oil consumption equivalent ($litres/m^2$), are presented in Table 4.

Although the energy inputs required to maintain the two growing regimes are higher in Boston than in Lymington (by 7% for unscreened warm crops), the potential savings due to cool growing are, in absolute terms, almost identical. Thus, cool growing can be expected to save the equivalent of about 7 $litres/m^2$ oil where screens are not used, and about 6 $litres/m^2$ oil where screens are used. These figures are rather smaller than those calculated in the Year One Report (16 and 14 $litres/m^2$ oil respectively) since these latter were based on the use of the actual glasshouse at Efford where the trials were carried out, which was much smaller than might be expected to be in use commercially. Growers with a glasshouse smaller than 0.25 hectares can assume that their potential savings will lie between the two sets of figures.

Table 4. Energy (Heating) Inputs Required for Cool-Grown and Commercial 'Warm' Poinsettia Crops.

		Total Energy Consumption (MJ/m^2)		Total Oil Consumption (lit/m^2)	
Location	**Crop Type**	**Without Screen**	**With Screen**	**Without Screen**	**With Screen**
Lymington	Cool	606.5	455.4	16.8	12.7
Lymington	Warm	855.7	670.3	23.8	18.6
Boston	Cool	669.0	502.1	18.6	13.9
Boston	Warm	919.5	717.8	25.5	19.9
Lymington - warm minus cool:		249.2	214.9	7.0	5.9
Boston - warm minus cool:		250.5	215.7	6.9	6.0

2.4 CULTIVAR TRIALS

Ten commercial cultivars were grown on four grower sites to assess their performance. These included both 'new' cultivars and commercial controls: Cortez, Freedom, Lilo, Monet, Picacho, Red Baron, Red Sails, Red Splendour, Sonora and Success. All came from one source - W.J. Findon of Stratford-upon-Avon. The sites were: 1, H. Evans, Europa Nursery, Hadlow, Kent;

2, Double H Nurseries, Gore Road, New Milton, Hants; 3, Oakheart Ltd, Stapleton, Leicestershire; 4, Tyson and Colleta, Hull, East Yorkshire. Crops were grown as per standard practice on each nursery, with pinching carried out between leaves 5-7. No day extension or night-break lighting was given on site 4 and assimilation lighting was given for a period on site 1 instead of night-break or day extension. CO_2 was applied on site 2. Plant growth regulators were applied more often in the south of the country on sites 1 and 2 than sites 3 and 4. On site 4, no plant growth regulator was used at all. Further cultural details are given in Appendix X.

Shelf-life performance of these selected cultivars was carried out in the shelf-life facilities at Efford. These plants were subjected to the same conditions in shelf-life as outlined for the main trial. Assessments were made at weekly intervals for 6 weeks. Records taken were as outlined above for the main trial and are presented in Appendix XI.

3. RESULTS AND DISCUSSION

3.1 MAIN TRIAL (13cm pots)

Plates of treatment comparisons are shown in Appendix V.

3.1.1 Plant Height

Plants were generally shorter in the second year of the trial compared with the first year, and some treatments resulted in plants which were shorter than the 28-34 cm height specification. However, the interpretation of height records has to be done with caution since plots were treated with cycocel according to the need (identified by graphical tracking) to meet the marketing specification for height. Plant height data need, therefore, to be considered in the light of total cycocel application (see Table 5).

Table 5. Application of Chlormequat (as Cycocel 46% a.i.) in total, as a percentage of the control treatment (Week 31 Warm), and number of spray applications

	Week 28 Cool			Week 30 Cool			Week 31 Warm		
Cultivar	Total*	%	No. Sprays	Total*	%	No. Sprays	Total*	%	No. Sprays
Freedom	3220	93	9	2760	80	7	3450	100	9
Ria	5290	115	14	5060	110	12	4600	100	11
Sonora	3680	123	10	3450	115	9	2990	100	8
Red Sails	6210	108	16	5520	96	13	5750	100	13

* Calculated for direct comparison with Year 1 as p.p.m. x number of applications (some applications were at half-rate).

There was a lesser need for cycocel application in 1996 than in 1995; comparing total active ingredient applied to the three common cultivars grown 'warm' in the two years, Freedom, Sonora and Red Sails, showed a reduction in 1996 of 39% (average of potting weeks 30 and 32 in 1996 versus potting week 31 in 1996). This could not be accounted for by lower light levels in 1996 (see section 2.3.7), and the most probable cause was poor establishment, reducing overall vigour.

Because growth was less vigorous in 1996 than in 1995, it is to be expected that differences in cycocel application between warm and cool growing would be less marked (cool growing in 1995 reduced cycocel application averaged over 10 cultivars for the same week potting by 62%). Direct comparisons are complicated, however because cool-grown plants were potted earlier than warm-grown plants in 1996. Experience in 1995 showed that a two-week earlier

potting increased the need for cycocel by between 44% (warm crops) and 139% (cool crops), but that when cool-grown pots were potted two weeks earlier than warm-grown pots, the requirement for cycocel was actually reduced (by between 9% and 45%). In contrast, a one-week earlier potting for cool-grown pots in 1996 gave no reduction in the need for cycocel, and a 3-week earlier potting increased the need by 10%. Furthermore, the 3 week earlier potting increased the number of cycocel applications in all cultivars except Freedom. Of the four cultivars grown in 1996, Freedom was the only one where cooler growing allied to three weeks earlier potting, reduced cycocel use (by 7%) and the only one showing substantial savings in growth regulator use when potting was just one week earlier (20%) (see Table 5).

Effects of light on height

There were no significant differences for any given cultivar, between plant height due to light level (see Table 6) after averaging over temperatures and spacings. There were, however, significant differences between cultivars with Red Sails being the tallest (even having received the most growth regulator).

Table 6. Mean Plant Height at Marketing

Cultivar	Light level	Plant Height (cm)
Freedom	Ambient	27.2 c
	Shaded	26.3 bc
Ria	Ambient	27.6 c
	Shaded	26.2 bc
Sonora	Ambient	25.7 ab
	Shaded	24.5 a
Red Sails	Ambient	31.1 d

LSD ($P = 0.05$) = 1.3; a, b, c and d denote where figures are significantly different

Height differences between cultivars, within growing regimes

Red Sails was consistently taller than the other three cultivars in all regimes (see Table 7). Ria and Sonora were the shortest when potted in week 31 and grown warm, but these effects were less obvious when the cultivars were grown cool.

Table 7. Mean Plant Height

Regime	Cultivar	Plant Height (cm) Ambient light	Shade
Week 28 cool:	Freedom	27.9 ab	27.1 ab
	Ria	30.3 c	29.1 b
	Sonora	26.6 a	25.6 a
	Red Sails	32.6 c	-
Week 30 cool:	Freedom	23.9 ab	21.8 a
	Ria	26.0 bc	25.2 b
	Sonora	24.0 ab	22.6 a
	Red Sails	28.0 c	-
Week 31 warm:	Freedom	30.2 b	30.0 b
	Ria	26.5 a	24.2 a
	Sonora	26.4 a	25.4 a
	Red Sails	32.9 c	-

LSD = 2.3 (P = 0.05); a, b, and c denote where figures within a regime are significantly different

Comparisons of height across growing regimes

Spacing, like light level, also had remarkably little influence on plant height. However, this might not have been the case had the crops been more vigorous.

Freedom: Cool-grown plants potted just one week (week 30) before control 'warm' plants were much too short for retail specifications, regardless of light and spacing regime. This height differential largely disappeared, however, when they were potted three weeks before the controls (week 28) (see Table 8).

Ria: Cool-grown plants potted in week 30 were as tall as the control 'warm' plants potted one week later. However, both tended to be too short. Plants of acceptable height were produced by potting in week 28 and growing cool.

Sonora: This responded like Freedom, with cool-grown plants having to be potted three weeks before the control plants to reach the same height. Overall, plants of Sonora were shorter than the minimum height specification.

Red Sails: As Freedom and Sonora, cool-grown plants of Red Sails had to be potted three weeks before the control plants to reach the same height.

Table 8. Mean Plant Height

Cultivar	Plant Height (cm)			
	Ambient Light		Shaded	
	10 plants/m^2	12 plants/m^2	10 plants/m^2	12 plants/m^2
Freedom:				
Week 28 cool	27.3 cde	28.5 de	26.1 bcd	28.1 de
Week 30 cool	23.3 ab	24.4 abc	21.8 a	21.8 a
Week 31 warm	29.7 e	30.3 e	29.7 e	30.3 e
Ria:				
Week 28 cool	30.5 e	30.1 e	29.6 de	28.5 cde
Week 30 cool	26.4 bcd	25.6 abc	25.6 abc	24.8 ab
Week 31 warm	27.3 cde	25.7 abc	25.4 abc	23.1 a
Sonora:				
Week 28 cool	26.9 bc	26.3 bc	25.7 abc	25.5 abc
Week 30 cool	24.2 abc	23.7 ab	22.7 a	22.5 a
Week 31 warm	27.1 c	25.7 abc	26.1 bc	24.8 abc
Red Sails:				
Week 28 cool	33.6 c	31.5 bc		
Week 30 cool	29.8 b	26.2 a		
Week 31 warm	33.2 c	32.5 bc		

LSD = 3.2 (P = 0.05); a, b, c, d, and e denote where figures within cultivars are significantly different

3.1.2 Plant Diameter

Effects of spacing on plant diameter

Closer spacing reduced plant diameter, although the difference was small (see Table 9).

Table 9. Mean Plant Diameter

Spacing	Plant Diameter (cm)
10 plants/m^2	42.7 a
12 plants/m^2	42.1 b

LSD = 0.56 (P = 0.05); a and b denote where figures are significantly different

Effects of light on plant diameter

The use of shade to reduce light level significantly reduced the diameter of Ria (Table 10). There were no significant differences between ambient light and shade for Freedom and Sonora when averaged across growing regimes.

Table 10. Mean Plant Diameter

Cultivar	Plant Diameter (cm) Ambient light	Shaded
Freedom	40.8	40.6
Ria	44.2 a	43.1 b
Sonora	42.5	42.0

LSD = 1.04 (P = 0.05); a and b denote where figures are significantly different

Plant diameter differences between cultivars within growing regimes

Freedom was generally the most compact cultivar, particularly when potted in week 30 and grown cool (see Table 11). Ria generally had the largest diameter, particularly in the cooler growing regimes. Shade reduced the diameter of Ria only in the week 31 warm regime.

Table 11. Mean Plant Diameter

Regime	Cultivar	Plant Diameter(cm) Ambient light	Shaded
Week 28 cool	Freedom	42.1 a	42.4 a
	Ria	45.8 c	44.4 bc
	Sonora	43.3 ab	42.8 ab
	Red Sails	43.4 ab	-
Week 30 cool	Freedom	37.2 a	36.4 a
	Ria	41.1 bc	41.8 c
	Sonora	40.3 bc	39.8 b
	Red Sails	40.9 bc	-
Week 31 warm	Freedom	43.2 a	43.0 a
	Ria	45.7 b	43.0 a
	Sonora	43.9 ab	43.4 a
	Red Sails	46.4 b	-

LSD = 1.8 (P = 0.05); a, b and c denote where figures within a regime are significantly different

Comparisons of plant diameter across growing regimes

All cultivars potted in week 30 and grown cool showed a smaller plant diameter than the control 'warm' plants potted one week later. This reduction in plant size was overcome in all but Red Sails by potting the cool grown plants three weeks before the controls. Except for Ria (see above) light level and spacing had no obvious effect on plant diameter (see Table 12).

Table 12. Mean Plant Diameter

Cultivar/Regime	Plant Diameter (cm)			
	Ambient Light		Shaded	
	10 plants/m^2	12 plants/m^2	10 plants/m^2	12 plants/m^2
Freedom:				
Week 28 cool	42.0 b	42.1 b	41.9 b	43.9 b
Week 30 cool	36.6 a	37.8 a	36.5 a	41.2 a
Week 31 warm	43.1 b	43.3 b	44.0 b	42.5 b
Ria:				
Week 28 cool	46.3 e	45.3 e	44.8 de	43.9 cd
Week 30 cool	41.4 abc	40.8 a	42.5 abcd	41.2 ab
Week 31 warm	47.3 e	44.2 d	43.6 bcd	42.5 abc
Sonora:				
Week 28 cool	42.6 bc	44.1 c	43.1 c	42.5 bc
Week 30 cool	40.4 ab	40.1 ab	40.2 ab	39.4 a
Week 31 warm	43.9 c	43.8 c	44.3 c	42.5 bc
Red Sails:				
Week 28 cool	43.5 cd	43.3 c		
Week 30 cool	42.2 b	39.5 a		
Week 31 warm	46.9 e	45.9 e		

LSD = 2.54 (P = 0.05); a, b, c, d, e denote where figures within cultivars are significantly different

3.1.3 Number of Bract Stars

Ria generally had fewer coloured stars per plant than the other three cultivars (see Table 13). Light level, spacing and growing regime had no significant effect on this character.

Table 13. Mean Number of Bract Stars per Plant

Cultivar	Light Level	Number of Coloured Bracts per Plant
Freedom	Ambient	5.5 b
	Shaded	5.4 ab
Ria	Ambient	5.1 a
	Shaded	5.2 a
Sonora	Ambient	5.5 b
	Shaded	5.3 ab
Red Sails	Ambient	5.4 ab

LSD = 0.27 (P = 0.05)

3.1.4 Size of Bract Stars

Mean star diameter data was angle transformed in order to carry out statistical analyses. Where statistically significant differences are discussed in the following text, they refer to calculations made on this transformed data. However, for ease of reference, the data are presented in the following text as actual treatment means. Star size was graded as follows: A = >225mm diameter; B = 200 - 225mm diameter; C = 150 - 200mm diameter; D = <150mm diameter.

Effects of growing conditions on bract star size

Both close spacing and shading tended to have deleterious effects in increasing either the percentage of bract stars in the smallest size category or reducing the percentage of bract stars in the largest size category (see Tables 14 and 15).

Freedom: Plants potted in week 28 and grown cool showed very similar star size distributions as control plants. Cool plants potted later tended to have a reduced number of large heads and, at 10 plants/m^2 , more small stars.

Ria and Sonora: Cool-grown plants, whenever potted, had a smaller percentage of large stars.

Red Sails: Whilst cool-grown plants potted in week 30 showed a similar star size distribution to control plants, those potted earlier had a larger percentage of large stars.

Table 14. Mean Percentage of Stars in Different Size Categories

Spacing	Size Grade A	B	C	D
10 plants/m^2	45.6	23.8	25.0	5.5 a
12 plants/m^2	44.5	24.1	24.9	7.0 b
	N.S.	N.S.	N.S.	*
Spacing/Regime				
10 plants/m^2				
Week 28 cool grown	38.1	19.2	24.6	5.6 a
Week 30 cool grown	29.1	25.1	25.8	7.4 a
Week 31 warm grown	51.3	17.6	16.1	2.4 b
	N.S.	N.S.	N.S.	*
12 plants/m^2				
Week 28 cool grown	36.6	21.3	20.7	8.9
Week 30 cool grown	29.8	26.7	27.0	5.3
Week 31 warm grown	49.3	14.9	17.9	5.6
	N.S.	N.S.	N.S.	N.S.
Variety/light level				
Freedom:				
Ambient light	46.4 c	22.9	24.1 ab	6.6 bc
Shaded	42.1 a	19.6	28.0 bc	10.4 c
Ria:				
Ambient light	51.8 d	25.2	20.2 a	4.7 ab
Shaded	46.5 c	25.5	20.4 a	7.5 bc
Sonora:				
Ambient light	42.3 b	24.2	26.4 ab	7.0 ab
Shaded	35.3 a	23.6	33.3 c	7.5 bc
Red Sails:				
Ambient light	48.0 c	25.3	23.6 ab	3.3 a
	***	N.S.	**	*

a, b, c and d denote where figures are significantly different (angle transformed data).

Table 15. Mean Percentage of Stars in Different Size Categories

	Ambient Light								Shaded							
	10 plants/m²				12 plants/m²				10 plants/m²				12 plants/m²			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Freedom:																
Week 28, cool grown	51.2	19.5	25.6	3.7	48.0	20.6	20.1	11.3	42.3	14.7	33.0	11.2	47.0	13.9	22.9	16.3
Week 30, cool grown	39.8	17.0	30.7	12.5	39.0	26.3	30.3	4.4	31.1	28.2	28.7	11.9	40.5	19.0	31.0	9.5
Week 31, warm grown	49.0	28.4	19.2	3.4	51.1	25.6	18.9	4.4	47.1	23.0	23.0	5.8	44.5	18.6	29.4	7.5
Ria:																
Week 28, cool grown	46.2	21.2	26.4	6.2	41.2	38.8	15.3	4.7	47.0	26.5	21.7	4.8	28.9	33.8	22.9	14.5
Week 30, cool grown	33.7	33.7	27.5	5.0	35.4	42.7	29.3	3.7	37.9	34.2	20.3	6.3	32.8	31.6	29.2	6.4
Week 31, warm grown	81.7	10.0	7.2	1.1	72.4	5.0	15.4	7.2	70.7	12.9	14.1	2.3	61.6	14.0	14.0	10.5
Sonora:																
Week 28, cool grown	29.9	29.3	35.1	4.5	34.7	27.5	26.2	11.6	27.6	26.9	37.5	8.0	32.7	19.2	37.6	10.4
Week 30, cool grown	21.5	32.4	32.7	13.4	33.4	27.7	33.2	5.7	30.4	25.8	34.8	9.0	17.6	35.6	37.8	7.8
Week 31, warm grown	60.6	20.1	18.2	1.1	73.5	8.3	12.7	5.6	54.8	14.3	27.3	3.6	48.7	20.0	25.0	6.2
Red Sails:																
Week 28, cool grown	60.8	15.2	17.7	6.3	60.3	16.7	20.5	2.6	-	-	-	-	-	-	-	-
Week 30, cool grown	38.4	29.2	31.3	1.1	39.9	30.6	25.0	4.6	-	-	-	-	-	-	-	-
Week 31, warm grown	46.2	32.3	19.4	2.1	42.2	27.8	27.7	3.3	-	-	-	-	-	-	-	-

3.1.5 Bract Colouring and Visible Cyathia

The influence of light level

Light level did not significantly influence the dates of either bract colouring or the appearance of visible cyathia (see Table 16). There were, however, significant differences between cultivars for both of these dates. The earliest bract colouring and cyathia development was shown by Freedom, and the latest by Ria.

Table 16. Mean Dates of Bract Colouring and Visible Cyathia (as calendar day number)

Cultivar	Light Level	Bract Colouring	Visible Cyathia
Freedom	Ambient	288.7 a	300.0 a
	Shaded	289.6 ab	300.2 a
Ria	Ambient	299.8 e	309.8 d
	Shaded	300.4 e	310.1 d
Sonora	Ambient	289.9 bc	303.9 b
	Shaded	290.7 c	305.1 c
Red Sails	Ambient	294.0 d	304.9 c
		LSD = 0.94	LSD = 0.89
		$P = 0.05$	$P = 0.05$

a, b, c, d, e denote where figures are significantly different

Interactions between light level and regime

There was a significant interaction between cultivar, light level and regime. Although light level did not have a significant influence when data were averaged over regimes (see above), some significant effects were observed for specific regimes. Thus, for plants potted in week 31 and grown warm, shade significantly delayed the date of development of first bract colour in Freedom and Sonora. For plants potted in week 28 and grown cool, shade significantly delayed the date of first visible appearance of cyathia in Ria. Overall, however, these differences were slight (Table 17).

Effects of regime

Freedom: There appeared to be no adverse effect of growing cool on either the speed of bract coloration or cyathia development and, where differences were shown, the cool-grown plants were ahead of the warm plants (Table 18). Similarly potting date had no obvious effect on

cool-grown plants, presumably because both sets of plants initiated at the same time, when daylength shortened sufficiently. Neither spacing nor light level influenced the date of bract colouring or of visible cyathia development of cool-grown plants, but shading delayed bract colour development in warm-grown plants.

Table 17. Mean Date of Bract Colouring and Development of Visible Cyathia (as calendar day number)

Regime	Cultivar	Bract Colouring		Visible Cyathia	
		Ambient	Shaded	Ambient	Shaded
Week 28 Cool	Freedom	288.1a	288.0 a	297.4 a	297.3 a
	Ria	299.1 c	300.0 c	305.3 c	308.2 d
	Sonora	288.5 a	288.0 a	302.7 b	303.8 bc
	Red Sails	292.3 b	-	304.0 bc	-
Week 30 Cool	Freedom	288.0 a	288.2 a	300.8 a	300.9 a
	Ria	300.3 c	300.8 c	312.3 d	311.9 d
	Sonora	288.1 a	288.4 a	303.6 b	304.7 bc
	Red Sails	294.0 b	-	305.4 c	-
Week 31 Warm	Freedom	289.9 a	292.6 b	301.8 a	302.4 a
	Ria	300.1 d	300.3 d	311.9 d	310.4 d
	Sonora	293.2 b	295.8 c	305.4 bc	306.8 c
	Red Sails	295.7 c	-	305.2 b	-
		LSD = 1.16		LSD = 1.54	
		P = 0.05		P = 0.05	

a, b, c, d denote where figures are significantly different

Ria: All plots reached the bract coloration stage together. However, plants potted in week 28 and grown cool developed visible cyathia significantly earlier than cool-grown plants potted in week 30, or the control warm-grown plants.

Sonora: Cool-grown plants tended to colour up and develop cyathia earlier than the control warm plants. Spacing had no significant influence, but control, warm plants coloured up earlier when grown under ambient light than under shade. Week 30 cool regime plants produced visible cyathia later when spaced at 12 pots/m^2 than when grown at 10 pots/m^2.

Red Sails: Bract colour developed earlier on plants potted in week 28 and grown cool than on plants potted in week 31 and grown warm.; regime had no obvious effect on the development of cyathia.

Table 18. Mean Date of Bract Colouring and Development of Visible Cyathia (as calendar day number):

Cultivar/Regime	Bract Colouring				Visible Cyathia			
	Ambient		Shaded		Ambient		Shaded	
	10 plants/m^2	12 plants/m^2	10 plants/m^2	12 plants/m^2	10 plants/m^2	12 plants/m^2	10 plants/m^2	12 plants/m^2
Freedom:								
Week 28, cool	288.2 a	288.0 a	288.0 a	288.0 a	297.7 a	297.0 a	297.0 a	297.5 a
Week 30, cool	288.0 a	288.0 a	288.0 a	288.4 a	301.1 bcd	300.4 b	301.4 bcd	300.4 b
Week 31, warm	290.8 b	289.6 a	293.8 c	291.4 b	300.8 bc	302.8 cd	301.5 bcd	303.2 d
Ria:								
Week 28, cool	299.4 a	298.8 a	299.3 a	300.8 a	305.8 a	304.7 a	306.6 a	309.8 b
Week 30, cool	300.5 a	300.1 a	301.0 a	300.6 a	311.1 bc	313.5 d	311.5 bcd	312.2 cd
Week 31, warm	299.9 a	300.3 a	299.9 a	300.6 a	310.9 bc	312.9 cd	311.1 bc	309.6 b
Sonora:								
Week 28, cool	288.6 a	288.4 a	288.0 a	288.0 a	303.0 ab	302.4 a	303.9 abcd	303.6 ab
Week 30, cool	288.0 a	288.2 a	288.8 a	288.0 a	302.4 a	304.7 bc	303.5 ab	305.9 cd
Week 31, warm	293.8 b	292.6 b	296.1 c	295.5 c	305.6 cde	305.2 bcd	306.1 cd	307.4 d
Red Sails:								
Week 28, cool	291.8 a	292.9 ab	-	-	304.0 a	304.0 a	-	-
Week 30, cool	294.4 bc	293.6 abc	-	-	304.1 a	306.7 b	-	-
Week 31, warm	296.0 d	295.4 cd	-	-	305.8 ab	304.6 ab	-	-
	LSD = 2.29				LSD = 2.18			
	P = 0.05				P = 0.05			

a, b, c, d denotes where figures for comparisons within cultivars are significantly different

3.1.6 Cyathia Score

The influence of cultivar and light level.

Mean cyathia score was not significantly influenced by light level for data averaged across regime and spacing. Cultivar did significantly influence this score, with Freedom producing the lowest score overall. Its score, however, was only significantly lower than those for the other cultivars when grown under control, warm conditions. Thus, overall, cool growing had no deleterious effect on this character (Table 19).

Table 19. Mean Cyathia Score

Regime	Cultivar	Cyathia Score	
		Ambient Light	Shaded
Week 28, cool	Freedom	5.0	5.0
	Ria	5.0	5.0
	Sonora	5.0	5.0
	Red Sails	5.0	-
Week 30, cool	Freedom	5.0	5.0
	Ria	5.0	5.0
	Sonora	5.0	5.0
	Red Sails	4.9	-
Week 31, warm	Freedom	4.7 a	4.6 a
	Ria	5.0 b	5.0 b
	Sonora	5.0 b	5.0 b
	Red Sails	5.0 b	-

LSD = 0.165 (P = 0.05); a, b denote where figures within growing regimes are significantly different

3.1.7 Plant Quality

The influence of spacing and light level on quality

Closer spacing significantly reduced overall plant quality at marketing. Thus plants grown at 10 plants/m^2 averaged a score of 1.94, whilst those grown at 12 plants/m^2 averaged 1.74. Shading also significantly decreased the overall quality score of all three cultivars assessed

(Table 20).

Table 20. Mean Plant Quality Score

Cultivar	Light Level	Quality Score
Freedom	Ambient	2.08 c
	Shaded	1.78 bc
Ria	Ambient	1.96 c
	Shaded	1.58 ab
Sonora	Ambient	1.48 ab
	Shaded	1.35 a
Red Sails	Ambient	2.67 d

LSD = 0.31 (P = 0.05); a, b, c, d denotes where figures are significantly different

The influence of spacing, light level, cultivar and regime on quality

Overall, Sonora had the lowest quality score of the four varieties assessed, and Ria had the highest (Table 21).

Freedom: The quality of plants potted in week 30 and grown cool was significantly poorer than that of plants potted either in week 28 and grown cool, or in week 31 and grown warm. Spacing and light level had no significant influence on the quality score.

Ria / Sonora: Cool grown plants appeared to show as high a quality score as the control warm plants, particularly when potted early (week 28).

Red Sails: Cool grown plants appeared to show as high a quality score as the control warm plants when potted early (week 28) and at standard density, but quality was reduced when planted later at higher density.

Table 21. Average Plant Quality Score

Cultivar/Regime	Quality Score: Ambient Light 10 plants/m^2	Ambient Light 12 plants/m^2	Shaded 10 plants/m^2	Shaded 12 plants/m^2
Freedom				
Week 28 cool	2.25 def	2.50 ef	1.75 bcde	1.88 cdef
Week 30 cool	1.13 abc	1.50 abcd	0.94 a	1.00 ab
Week 31 warm	2.63 f	2.50 ef	2.50 ef	2.63 f
Ria				
Week 28 cool	2.38 bc	2.63 c	2.38 bc	1.75 a
Week 30 cool	1.63 ab	1.38 a	1.63 a	1.38 a
Week 31 warm	2.38 bc	1.38 a	1.38 a	1.00 a
Sonora				
Week 28 cool	1.50 ab	1.63 ab	1.63 ab	1.13 a
Week 30 cool	1.13 a	1.00 a	1.13 a	1.13 a
Week 31 cool	2.00 b	1.63 ab	1.75 ab	1.38 ab
Red Sails				
Week 28 cool	2.88 b	3.00 b	-	-
Week 30 cool	2.88 b	1.38 a	-	-
Week 31 cool	3.00 b	2.88 b	-	-

LSD = 0.77 (P = 0.05); a, b, c denote where figures within growing regimes are significantly different

3.1.8 Shelf-Life

Data recorded during shelf-life assessments are presented graphically in Appendix VI. In terms of overall performance, shelf life was markedly improved by cool growing in Ria. However, the opposite was found to be the case for Red Sails and Sonora (particularly after 3 days sleeving), and there was no obvious effect of growing temperature for Freedom.

Cool grown plants of Sonora lost significantly more green leaves than warm grown plants, with length of sleeving having no obvious impact. A similar trend was found for Freedom (given 3 days of sleeving) and for Red Sails. Loss of green leaves from Ria was not greatly affected by temperature regime, but was improved by shading.

Temperature regime had little effect on the number of red bracts / leaves dropped by Freedom and Ria during shelf life. However, Sonora and Red Sails lost more red bracts/leaves having been grown cool, regardless of length of time sleeved.

Green leaf colour gradually faded during the shelf-life period for all treatments. The warm growing regime appeared to accelerate leaf colour loss during shelf-life of Ria. Red bracts / leaves of Freedom, Sonora and Red Sails lost colour more rapidly during shelf-life following production in a cool regime.

Cyathia loss was generally not influenced by growing regime, except in the case of Ria, where cool growing reduced cyathia loss during the shelf-life period.

Sleeving had little effect on shelf-life in general, although it did appear to increase early leaf loss of cool-grown Freedom plants.

3.1.9 Shelf-Life of Red Sails

As found for plants grown at Efford, growing in a cool regime generally increased the number of green leaves lost during shelf-life. The number of red bracts/leaves lost was also greater in the cooler regime, although this was not noted for Efford plants. Length of sleeving did not appear to influence either the number of green leaves or red bracts/leaves lost during shelf-life.

Loss of colour from green leaves increased with length of time in shelf-life, but this colour loss was not influenced by growing regime or length of time sleeved. Loss of bract colouration also increased with time, and was greatest in the cool-grown plants. Bract colour loss was not influenced by length of sleeving period.

All treatments had a high score for cyathia loss (indicating poor retention after 27 days or more of shelf-life) but this appeared not to be influenced by either growing regime or length of the sleeving period.

Warm grown plants were superior to cool grown plants in terms of overall performance score, but the difference did not become marked until the plants had been in shelf-life for at least 27 days. Furthermore, the worst score recorded for cool grown plants at the end of the shelf-life period was 3.3, indicating acceptable quality given the age of the plants at this point (i.e. 41 days from sleeving).

3.1.10 Summary - Main Trial

Unlike in 1995, cooler growing with earlier potting did not result in a reduced use of cycocel; potting 3 weeks before the warm crop actually increased use by 10%. Clearly cycocel use is influenced by vigour of growth and it is possible that the results in 1995 were more typical of what one might expect from a cool-growing regime than those in 1996.

Cooler growing with 2 weeks earlier potting gave plants of acceptable height in 1995. In general plants were shorter in 1996 and control plants of Ria and Sonora failed to reach the minimum height of 28cm. Cool-grown plants potted one week before the controls were even shorter, but cool-grown plants potted 3 weeks before the controls were at least as tall as the controls, and in the case of Ria, taller. Thus, height should not be a problem with cool growing so long as plants are potted 2-3 weeks earlier than usual. These results may be expected to apply both in the North and South of the UK, since the use of shade did not influence the trends observed. Spacing did not affect plant height, but greater plant vigour in another year might be expected to increase competition at the closer spacing.

Potting in week 30 with cool growing (one week before the controls) significantly decreased plant diameter in all four cultivars (ambient light, 10 plants / m^2), but this reduction was overcome in all cultivars except Red Sails by potting the cool-grown plants three weeks before the controls. Except for Ria (where plant diameter of control plants was reduced by shading) light level had no obvious influence on plant diameter. Similarly, closer spacing only reduced the diameter of unshaded, warm-grown plants of Ria, and had no effect on week 28 potted cool plants.

Temperature regime had no adverse effect on numbers of bract stars per pot. However, cooler growing significantly reduced the percentage of the largest size grade bract stars in the cultivars Ria and Sonora, even when planted three weeks earlier. Reductions in size were overcome in Freedom by potting three weeks earlier, and in Red Sails by potting one week earlier. A tendency to produce smaller bract stars was also noted in 1995. Closer spacing and shading also tended to have deleterious effects on bract star size.

The date of bract colour in the cultivars Freedom and Ria was not influenced by temperature regime, but was slightly earlier in cool-grown plants of Sonora and Red Sails. Cyathia also generally appeared first in the earlier potted cool-grown plants. Effects of shading and spacing on these characters were slight. Cool-growing had no deleterious effect on cyathia score (quality).

Taking account of all of these effects (by assigning plant quality scores) showed that cool-growing produced plants of as high a quality as the control plants at the point of marketing, so long as potting was three weeks earlier than for the controls (week 28). Potting only one week earlier gave plants of a lower quality than the controls. Quality of the week 28 cool-grown plants was not adversely affected by closer spacing under ambient light conditions, but this may not be the case every year since, in general, closer spacing and shading did reduce plant quality. Cool growing improved subsequent shelf life in Ria, but tended to have a slight negative impact on Sonora and Red Sails by encouraging earlier leaf and bract drop, and accelerating the fading of bract colour. Similar effects were not seen in 1995. Commercially

cool-grown plants of Red Sails also showed greater leaf and bract loss during shelf life. Sleeving, both in the Efford trials and in commercially grown Red Sails, had little obvious effect on shelf life in general, although it did appear to increase early leaf loss of cool-grown Freedom plants.

3.2 SUB-TRIAL (10cm pots)

3.2.1 Plant Height

Plant height at marketing was between 12 and 17cm depending on cultivar and treatment. As with the main trial, all cultivars were treated with cycocel according to requirement, and cycocel use needs to be taken into consideration in considering height differences.. To evaluate plant height, therefore, it is necessary to consider differences in cycocel applications (Table 22).

Table 22. Total Chlormequat applied* (as Cycocel 46% a.i.)

Cultivar	Regime		
	Week 34 Cool	Week 35 Cool	Week 35 Warm
Cortez	5060	4140	5060
Freedom	4600	4140	5060
Red Splendour	4600	4140	5060
Ria	5060	4140	5060
Sonora	5060	4140	5060

* p.p.m. x number of applications

Cool-grown plants potted in the same week as the controls required 18% less cycocel. However, only in Freedom and Red Splendour was there a saving in growth regulator when potting was one week earlier.

The influence of regime on height

Averaged over temperature treatment and spacing, plants of Freedom were the tallest and plants of Sonora were the shortest (Table 23). Control plants closely approached the lower height specification (18 cm) in all cases except Sonora, but cool-grown plants were significantly shorter, whether potted in the same week or one week later (see Table 24). Pot spacing had no influence on this outcome. A two or three week earlier potting (as in the main trial) would probably have been required to produce plants of comparable height.

Table 23. Mean Plant Height

Plant height (cm)				
Cortez	**Freedom**	**Red Splendour**	**Ria**	**Sonora**
15.3	16.3	14.6	15.1	13.9

LSD = 0.52 (P = 0.05); a, b, c, denote where figures are significantly different.

Table 24. Mean Plant Height

Cultivar/Regime	**Plant height (cm)**	
	22 plants/m^2	**26 plants/m^2**
Cortez:		
Week 34 cool	15.0 a	14.8 a
Week 35 cool	14.1 a	14.1 a
Week 35 warm	17.3 b	16.9 b
Freedom:		
Week 34 cool	15.7 a	15.5 1
Week 35 cool	15.5 a	15.5.a
Week 35 warm	17.4 b	18.4 b
Red Splendour:		
Week 34 cool	14.6 a	14.1 a
Week 35 cool	12.2 a	12.8 ab
Week 35 warm	17.3 c	16.8 c
Ria:		
Week 34 cool	14.3 bc	14.8 c
Week 35 cool	13.0 ab	12.8 a
Week 35 warm	17.8 d	17.9 d
Sonora:		
Week 34 cool	13.9 b	13.4 ab
Week 35 cool	12.3 a	12.1 a
Week 35 warm	16.1 c	15.6 c

LSD = 1.28 (P = 0.05); a, b, c, d denote where figures are significantly different

3.2.2 Plant Diameter

A very similar trend to that for plant height was shown for plant diameter (see Table 25). Plants grown cool and planted in the same week as the control warm plants had a significantly reduced diameter, and planting one week earlier did not fully compensate for lower temperature in any of the five cultivars. There was little effect of spacing on plant size but, in general, cultivars and regimes giving the greatest plant diameter were most affected by closer spacing. In particular, the closer spacing treatment reduced plant diameter in Cortez, Freedom and Ria grown warm. Averaged over all treatments, Red Splendour was the most compact cultivar (diameter 22.5 cm), whilst Ria and Cortez had the largest mean diameters (28.2 and 28.4 cm respectively).

Table 25. Mean Plant Diameter

Cultivar/Regime	Plant Diameter (cm)	
	22 plants/m^2	26 plants/m^2
Cortez:		
Week 34 cool	27.1 a	26.2 a
Week 35 cool	26.1 a	27.1 a
Week 35 warm	32.7 c	31.5 b
Freedom:		
Week 34 cool	24.0 a	25.4 c
Week 35 cool	25.3 bc	24.3 ab
Week 35 warm	29,3 e	28.0 d
Red Splendour:		
Wee 34 cool	21.9 c	21.1 bc
Week 35 cool	20.3 ab	19.7 a
Week 35 warm	25.9 d	26.2 d
Ria:		
Week 34 cool	27.7 b	27.2 b
Week 35 cool	24.6 a	24.9 a
Week 35 warm	33.2 d	32.0 c
Sonora:		
Week 34 cool	24.0 b	24.8 b
Week 35 cool	23.9 ab	23.0 a
Week 35 warm	31.6 c	31.1 c

LSD = 0.95 (P = 0.05); a, b, c, d, e denote where figures are significantly different

3.2.3 Number of Bract Stars

All cultivars produced an average of 4 to 5 coloured bract stars per plant (Table 26), and this was not significantly influenced either by spacing or temperature regime.

Table 26. Mean Number of Bract Stars per Plant

Cortez	Freedom	Red Splendour	Ria	Sonora
4.8 b	4.9 b	4.4 a	4.8 b	5.1 c

LSD = 0.17 (P = 0.05); a, b, c, denote where figures are significantly different

3.2.4 Size of Bract Stars

Mean bract star size data were angle transformed prior to statistical analysis, and where significant effects are discussed in the following text, they refer to calculations made on this transformed data. For ease of reference, however, data presented in the following text represent actual treatment means. As for the main trial, the following star size grades were used: A = >225mm diameter; B = 200 - 225mm diameter; C = 150 - 200mm diameter; D = <150mm diameter.

Cultivar differences

Averaged over treatments, Cotez and Ria produced the largest percentage of large bract stars (>225 mm diameter) and Red Splendour produced the largest percentage of small bract stars (<150mm diameter) (Table 27).

Table 27. Mean Percentage of Bract Stars in the Different Size Grades

Cultivar	Size Grade			
	A	B	C	D
Cortez	12.0 b	15.6 c	49.9 c	22.3 a
Freedom	5.6 a	17.6 c	50.5 c	25.9 a
Red Splendour	0.0 a	3.4 a	25.3 a	71.3 c
Ria	16.1 b	6.8 a	31.8 b	45.4 b
Sonora	6.2 a	9.5 b	38.1 b	46.2 b

a, b, c denote where angle transformed data are significantly different

The influence of regime

Bract star size was markedly reduced in both cool treatments (Table 28). Spacing had relatively little effect on the size distributions.

Table 28. Mean Percentage of Bract Stars in the Different Size Grades

Cultivar/Regime	A		B		C		D	
	22 plants/m²	26 plants/m²	26 plants/m²	26 plants/m²	22 plants/m²	26 plants/m²	22 plants/m²	26 plants/m²
Cortez:								
Week 34 cool	0.0 a	2.6 a	18.6 ab	9.1 a	53.3 abc	59.2 bc	28.1 b	29.1 b
Week 35 cool	0.0 a	1.3 a	9.6 a	8.9 a	61.8 c	48.1 abc	28.6 b	41.7 b
Week 35 warm	34.5 b	33.5 b	23.2 b	24.3 b	39.7 ab	37.1 a	2.6 a	3.8 a
Freedom:								
Week 34 cool	1.3 a	3.8 a	20.0 bc	15.2 b	53.7	51.3	23.8 ac	29.7 cd
Week 35 cool	1.2 a	0.0 a	3.7 a	5.0 a	46.5	60.0	47.3 d	35.0 cd
Week 35 warm	11.36	15.8 b	31.6 c	30.3 c	48.1	43.3	8.9 a	10.6 a
Red Splendour:								
Week 34 cool	0.0	0.0	0.0 a	0.0 a	13.4 bc	18.1 c	86.6 bc	81.9 b
Week 35 cool	0.0	0.0	0.0 a	0.0 a	0.0 a	4.5 b	10.0 d	95.5 cd
Week 35 warm	0.0	0.0	11.3 b	9.2 b	63.4 d	52.6 d	25.3 a	38.2 a
Ria:								
Week 34 cool	0.0 a	0.0 a	0.0 a	0.0 a	32.1	37.6	67.9 b	62.4 b
Week 35 cool	0.0 a	0.0 a	0.0 a	0.0 a	36.3	25.6	63.7 b	74.4 b
Week 35 warm	53.9 b	42.6 b	17.9 b	22.6 b	25.6	33.4	2.6 a	1.4 a
Sonora:								
Week 34 cool	0.0 a	0.0 a	0.0 a	1.2 a	33.9 a	39.9 ab	66.1 b	58.9 b
Week 35 cool	0.0 a	0.0 a	2.5 a	1.2 a	33.4 a	26.8 a	64.1 b	72.0 b
Week 35 warm	25.4 c	12.0 b	29.0 b	23.3 b	37.9 ab	56.4 b	7.7 a	8.3 a
	LSD = 8.1 (P = 0.05)		LSD = 9.2 (P = 0.05)		LSD = 11.9 (P = 0.05)		LSD = 12.2 (P = 0.05)	

3.2.5 Bract Colouring and Visible Cyathia

Bract colouring was significantly earlier in Cortez, Freedom, Red Splendour and Sonora, when these were grown cool (Table 29). Spacing did not influence the date of bract colouring. In contrast, the appearance of visible cyathia was generally delayed by cool growing (Table 29). Averaged over treatments, Sonora showed the earliest bract colouring and Red Splendour and Ria showed the latest (Table 30). Red Splendour and Sonora were the first to reach the stage of visible cyathia, and Ria was the latest (Table 30).

Table 29. Mean Date of Bract Colouring and Development of Visible Cyathia (as calendar day number):

Cultivar/Regime	Bract Colouring		Visible Cyathia	
	22 plants/m^2	26 plants/m^2	22 plants/m^2	26 plants/m^2
Cortez:				
Week 34 cool	288.9 a	290.2 a	310.9 b	311.4 b
Week 35 cool	293.9 b	293.4 b	311.5 b	313.5 b
Week 35 warm	294.8 b	294.4 b	308.2 a	308.9 a
Freedom:				
Week 34 cool	290.2 a	290.1 a	310.6 b	313.3 c
Week 35 cool	292.8 bc	291.5 ab	312.9 bc	311.2 bc
Week 35 warm	293.4 bc	294.1 c	303.6 a	304.0 a
Red Splendour:				
Week 34 cool	298.6 ab	298.2 a	306.a ab	308.9 c
Week 35 cool	298.2 a	298.3 a	308.1 bc	308.8 c
Week 35 warm	301.0 b	299.7 ab	304.3 a	304.0 a
Ria:				
Week 34 cool	298.4	298.3	317.4 b	318.1 b
Week 35 cool	298.7	299.3	319.7 b	319.5 b
Week 35 warm	297.3	297.7	310.0 a	310.5 a
Sonora:				
Week 34 cool	289.3 a	288.9 a	308.2 b	306.9 ab
Week 35 cool	288.4 a	288.0 a	307.2 ab	307.1 ab
Week 35 warm	293.9 b	295.1 b	304.7 a	306.1 ab
	LSD = 2.49 (P = 0.05)		LSD = 2.52 (P = 0.05)	

a, b, c denote where figures are significantly different

Table 30. Mean Date of Bract Star Colouring and Development of Visible Cyathia (as calendar day number):

	Cortez	Freedom	Red Splendour	Ria	Sonora
Bract Colouring	292.6 b	292.0 b	299.0 c	298.3 c	290.6 a
Visible Cyathia	310.7 c	309.3 b	306.7 a	315.9 d	306.7 a

Bract colouring: LSD = 1.02 (P = 0.05)

Visible cyathia: LSD = 0.96 (P = 0.05)

a, b, c, d denote where figures are significantly different

3.2.6 Cyathia Score

Ria had a lower cyathia score when grown cool (Table 31); in all other cultivars temperature had no effect on this character. Spacing also had no significant effect.

Table 31. Mean Cyathia Score

Cultivar/Regime	Cyathia Score	
	22 plants/m^2	26 plants/m^2
Cortez:		
Week 34 cool	5.00	5.00
Week 35 cool	5.00	4.88
Week 35 warm	5.00	5.00
Freedom:		
Week 34 cool	5.00	5.00
Week 35 cool	5.00	5.00
Week 35 warm	5.00	5.00
Red Splendour:		
Week 34 cool	5.00	5.00
Week 35 cool	5.00	4.88
Week 35 warm	5.00	5.00
Ria:		
Week 34 cool	4.38 ab	4.13 a
Week 35 cool	4.25 ab	4.63 b
Week 35 warm	5.00 c	5.00
Sonora:		
Week 34 cool	4.75	5.00
Week 35 cool	5.00	5.00
Week 35 warm	5.00	5.00

LSD = 0.49 (P = 0.05); a, b, c denotes where figures are significantly different

3.2.7 Plant Quality

After averaging over treatments, the lowest quality score was assigned to Sonora and the highest to Freedom and Ria (Table 32). For all five cultivars assessed, the highest quality score was achieved in pots grown in the week 35 warm regime (Table 33). Quality was as seriously reduced in the week 34 cool potting as in the week 35 cool potting. Spacing did not significantly influence quality score.

Table 32. Mean Quality Score

Cortez	Freedom	Red Splendour	Ria	Sonora
1.33 b	1.58 c	1.27 ab	1.43 bc	1.13 a

LSD = 0.19 (P = 0.05); a,b,c - denote where figures are significantly different

Table 33. Mean Quality Score

Cultivar/Regime	Quality Score	
	22 plants/m^2	26 plants/m^2
Cortez		
Week 34 cool	1.13 a	1.00 a
Week 35 cool	1.00 a	1.00 a
Week 35 warm	2.13 b	1.75 b
Freedom		
Week 34 cool	1.00 a	1.25 a
Week 25 cool	1.00 a	1.00 a
Week 35 warm	2.38 b	2.88 c
Red Splendour		
Week 34 cool	1.00 a	1.00 a
Week 35 cool	1.00 a	1.00 a
Week 35 warm	1.88 b	1.75 b
Ria		
Week 34 cool	1.06 a	1.13 a
Week 35 cool	1.00 a	1.00 a
Week 35 warm	2.00 b	2.38 b
Sonora		
Week 34 cool	1.00 a	1.00 a
Week 35 cool	1.00 a	1.00 a
Week 35 warm	1.38 a	1.38 a

LSD = 0.45 (P = 0.05); a,b denote where figures are significantly different

3.2.8 Summary - Sub Trial (10cm pots)

Cooler growing caused a significant reduction in plant growth so that, even when potting was advanced by one week, plant height, plant diameter and bract star size were all reduced compared to warm-grown control plants. This effect was also shown in the main trial (13 cm pots) but was largely compensated for by potting the cool-grown plants three weeks earlier. A similar compensation may have been shown in this sub-trial had potting of the cool plants been earlier.

As with the 13cm pots, bract colouring was promoted by cool growing, and was generally earlier when potting was one week earlier. Cyathia development, however, was later in cool grown plants. Overall, quality was severely depressed in the cool-grown pots. Shelf-life was not assessed.

3.3 CULTIVAR TRIALS

As in the first year of this project, the production of new cultivars was monitored on four commercial sites by Mr Harry Kitchener (see Materials and Methods).

Plant characteristics after pinching are shown in Table 34. More breaks were obtained from pinched plants on site 1, which used assimilation lighting, than any other site. The mean number of breaks (averaged over all cultivars and sites) was 6.2, with Red Splendour giving the most. Plant characteristics at marketing are shown in Table 35, with average plant heights and diameters being similar and within specification on the four nurseries. There were, however, regional differences in star production and star size per plant; these were larger on the two southern nurseries (1 and 2) than on the two northern nurseries (3 and 4). Data recorded during shelf-life assessments are presented graphically in Appendix XI. There was good agreement between the performance in shelf-life of plants of each cultivar produced on the four different sites, indicating that genotype had had a greater influence than growing environment.

Cortez: Pillarbox red bracts with dark green oak leaves. Branches produced at an angle and apical dominance apparent. Cyathia variable in size. Average to below average height, but more than average spread (except nursery 3). Adequate star number but above average star size. Coloured bracts/leaves began to pale in shelf life from day 5. Some bleaching of bract margins shown, as well as some bract edge necrosis. Overall shelf life performance was poor to average.

Freedom: Red bracts with dark green oak leaves. Upright red stems. Cyathia tending to be small. Average height (tall on nursery 3) and spread, average star number but with largest or near-largest star size. Overall appearance in shelf life was mostly affected by the loss of both coloured bracts/leaves and lower green leaves. Cyathia were lost early in shelf-life and a slight paling of bract colour was noted.

Lilo: Red bracts, with flat, dark green oak leaves. Upright habit with very prominent cyathia. Tall with average or above average spread. Above average star size shown on the northern nurseries. Severe bleaching/paling of coloured bracts/leaves was shown early in shelf-life, and this lowered the overall performance. Cyathia were also lost early, but green leaf colour remained strong and leaf retention was also good.

Monet: Bi-colour mauve on cream/white bract. Mauve towards the bract margin. Head flat, branches tending to spread. Leaves mid-green. Slightly above average height and spread. Star number among the best on each nursery, but stars tending to be of smaller than average size. Performed well throughout shelf life. Bract colour intensified rather than faded, and coloured

bracts/leaves remained bright and unmarked until day 42. The pale mid-green leaf colour detracted from overall appearance but there was good leaf retention.

Picacho: Brick red lanceolate bracts. Leaves light green and also lanceolate. Plants tended to be very short with below average spread (except nursery 3). Above average number of breaks early on, and this translated into higher than average star number on nurseries 2 and 4. Relative star size differed across nurseries; greater than average at 1 and 3 but smaller than average at 2 and 4. Bract colour was retained well during the early stages of shelf-life, with some fading towards the later stages. Number of lower leaves lost increased towards the end of shelf life, with those that were retained yellowing noticeably.

Red Baron: Plants supplied appeared unstable with bracts either very dark brick red and shiny, or pink red velvety (even within the same plant). Leaves light green. Shoots of purplish colour and rangy, and sparse of leaves at the base. Cyathia large. Plants suffered lower leaf loss during shelf life. Bracts were thin and became bleached and mottled in appearance, even at the point of marketing. Cyathia showing moderate retention by the end of shelf life.

Red Sails: Bracts salmon red, leaves dark oak leaf green. Upright with small cyathia. Among the tallest of cultivars but only average plant spread. Average star number and average to above average star size. Overall performance in shelf life moderate, with marked bleaching of bract edges as early as day 5. Cyathia were also lost early on.

Red Splendour: Bracts bright dark red. Foliage oak leaf dark green, with whitish vein and prominent. Cyathia of good size. Below average height (except nursery 1) and spread. Low star number and small star size. Good overall performance during shelf-life with little leaf loss, and good retention of colour in green leaves and red bracts/leaves throughout.

Sonora: Bracts bright red, some shading to green; leaves dark oak-leaf green. Cyathia small. One of the most compact of the cultivars, with an average to above average number of stars (star number particularly good on nursery 2). Star size tending to be below the average for all cultivars (except on nursery 1). Good overall shelf-life performance, with little lower leaf loss and bright red bracts which paled moderately with time. Cyathia started to drop by day 14.

Success: Bracts medium red. Small medium green leaves. Plants rangy with medium sized cyathia. Above average for height and spread. Average numbers of stars (but highest of all on nursery 1 and one of the worst on nursery 3) but these were very small. Notable lower leaf loss and yellowing of the lower leaves in shelf life. Coloured bracts/leaves were, however, generally retained. Bract colour faded slightly during shelf-life and cyathia were only lost towards the end of the test period

Table 34. Height to Pinch and Number of Breaks after Pinching

Site	1		2		3		4		
Date	13/10		10/9		3/9		4/10		
Cultivar	Height (cm)	No. Breaks	Height (cm)	No. Breaks	Height (cm)	No. Breaks	Height (cm)	No. Breaks	Mean No. Breaks
Cortez	5.6	7.1	4.6	5.2	4.9	6.3	3.9	5.5	6.0
Freedom	6.0	6.4	4.9	5.2	5.1	5.1	5.3	5.7	5.6
Lilo	7.2	6.1	5.2	5.1	5.6	5.1	5.3	5.7	5.5
Monet		6.4	6.7	5.5	5.7	7.5	6.6	4.9	5.86.2
Picacho	4.3	7.0	4.6	5.9	3.9	7.0	3.3	5.8	6.4
Red Baron	6.7	6.8	5.4	5.9	6.0	6.4	5.0	6.0	6.3
Red Sails	5.6	6.7	5.1	5.1	5.8	5.4	5.8	5.6	5.7
Red Splendour	5.2	7.8	4.5	6.3	4.6	6.7	3.6	5.9	6.7
Sonora	4.9	7.4	4.7	6.0	5.8	6.5	4.5	6.3	6.6
Success	6.1	6.9	5.4	5.4	6.2	6.5	6.1	5.8	6.2
Mean	5.8	6.9	5.0	5.6	5.5	6.2	4.8	5.8	6.1

Table 35. Plant Characteristics at Marketing

	Cultivar	Height (mm)	Width (mm)	No. Stars	Other Shoots*	Star Diam** (mm)
Site 1	Cortez	248.0	430.3	5.1	1.4	257.5
29/11	Freedom	264.0	424.3	4.3	1.7	259.8
	Lilo	268.8	415.8	5.0	0.6	220.0
	Monet	262.5	446.3	5.6	1.4	215.3
	Picacho	234.3	374.0	4.6	3.5	231.8
	Red Baron	256.0	400.3	4.5	1.4	194.5
	Red Sails	270.8	415.8	5.0	1.5	230.8
	Red Splendour	261.5	367.8	3.3	2.6	167.3
	Sonora	232.8	410.5	5.0	2.1	234.3
	Success	264.5	440.0	5.9	1.1	168.5
	Mean	**256.1**	**412.5**	**4.8**	**1.7**	**218.0**
Site 2	Cortez	221.0	492.3	4.0	0.9	258.3
28/11	Freedom	245.0	423.0	4.4	0.9	278.0
	Lilo	310.8	450.2	4.4	0.5	230.0
	Monet	256.0	508.3	5.0	0.0	203.3
	Picacho	191.8	423.0	5.4	3.2	189.8
	Red Baron	258.8	473.8	4.4	1.2	164.5
	Red Sails	277.8	455.8	4.7	0.4	251.0
	Red Splendour	228.5	421.0	4.2	1.2	204.0
	Sonora	228.8	479.3	5.7	0.8	225.7
	Success	253.8	466.0	4.7	0.6	164.5
	Mean	**247.2**	**459.3**	**4.7**	**1.0**	**216.9**

CONTINUED

Table 35 CONTINUED

	Cultivar	Height (mm)	Width (mm)	No. Stars	Other Shoots*	Star Diam** (mm)
Site 3	Cortez	258.0	406.3	4.0	2.0	227.3
6/12	Freedom	284.5	451.3	3.8	1.8	250.3
	Lilo	260.0	475.8	3.5	0.8	264.5
	Monet	249.0	496.5	4.4	2.0	201.3
	Picacho	172.8	453.3	3.6	2.2	216.8
	Red Baron	237.0	447.8	3.8	1.3	201.0
	Red Sails	265.0	445.5	4.0	1.9	224.5
	Red Splendour	234.0	375.0	2.6	3.6	164.3
	Sonora	224.3	347.3	3.6	2.5	178.0
	Success	251.5	452.3	3.3	2.8	134.0
	Mean	**243.6**	**435.1**	**3.7**	**2.1**	**206.2**
Site 4	Cortez	200.3	405.3	4.1	0.8	246.3
1/12	Freedom	253.0	392.8	4.2	1.4	233.5
	Lilo	361.1	449.1	4.1	0.6	243.6
	Monet	278.8	382.3	3.9	1.9	177.5
	Picacho	214.3	376.0	4.4	1.2	171.4
	Red Baron	255.3	406.5	3.7	1.6	174.8
	Red Sails	282.5	401.3	3.5	1.7	212.3
	Red Splendour	219.2	375.5	3.1	2.0	198.5
	Sonora	190.5	331.5	3.6	2.1	155.0
	Success	245.0	400.0	3.8	2.1	155.0
	Mean	**250.0**	**392.0**	**3.8**	**1.5**	**201.0**

* Other shoots: 10+ cm in length, but with bracts below the head (would not be within the specification).

** Based on the largest, most prominent star.

4. OVERALL DISCUSSION AND CONCLUSIONS

Poinsettias are a high input crop both in terms of energy use and labour, and whilst the costs of energy and labour are expected to rise in the years ahead, the market return for poinsettias is thought likely to remain fairly static. Thus, there is considerable interest in measures to reduce production costs, such as cool-growing, which appears to be widely practiced in Germany.

The concept of cool-growing was trialled at Efford in 1995 (see PC 71c First Year Report). Ten cultivars were grown as 13 cm pots at a day / night set point temperature of 15°C (venting at 1 - 2°C higher), and contrasted with a control 'warm' crop grown as per normal commercial practice. Since lower temperatures give a reduced rate of plant development, the cool crops were potted in weeks 28 and 30, whilst control crops were potted in weeks 30 and 32. Using a 0 (worst) - 2 (best) scale, overall plant quality at marketing was found to be comparable in the cool-grown crops (1.39 and 1.45 for weeks 28 and 30 respectively) to that of the control week 30 crop (1.44), but less good than the week 32 warm crop (1.78). Height specifications were reached in both cool crops but, of these, that potted in week 28 was judged the best since it had more 'bulk'. Bract star size tended to be smaller in the cool-grown crops, and these also tended to show a little more unevenness at marketing. There were no obvious differences in shelf life due to growing temperature, and no increased incidence of *Botrytis* stemming from the higher relative humidities which accompany cooler temperatures.

The cultivars judged to be most suitable for cool growing in the 1995 trials were Freedom, Liberty Red, Cortez, Sonora, Red Sails, Menorca and Maren. Bract star size was judged to be too small in Spotlight and Red Splendour, and Dark Puebla was very late to reach maturity.

Although cool growing was judged to have commercial potential in 1995, it was thought possible that less good results would have been achieved in a poorer light year or at more northerly locations. Thus, in 1996 the experiment was repeated, but with a shading treatment added (25 - 30% shading aimed at, but 35 - 45% achieved). The cool-grown 13 cm pots were potted in weeks 28 and 30, whilst the control pots were potted in week 31, and the cultivars were restricted to two which had done well the previous year, Freedom and Sonora, plus Ria and Red Sails (non-shaded treatment only). The slightly smaller plants produced by cool

growing in 1995 appeared to give scope for more intensive production, so a final density of 12 pots/m^2 was included in the 1996 trials as a contrast to the standard 10 pots/m^2 . Finally, the trials were extended to include comparisons of 10 cm pots (cultivars Freedom, Sonora, Cortez, Red Splendour and Ria).

The 1996 trials confirmed that cooler growing has to be accompanied by 2-3 weeks earlier potting. Thus the one week of additional growing which the week 30 cool pots (13 cm) were given was insufficient to compensate for lower temperature, and plant size and overall plant quality was markedly reduced, especially in Freedom and Sonora. Similarly, the one-week earlier potting of cool plants in the 10 cm trial resulted in greatly reduced quality. However, given three weeks earlier potting (week 28), cool-grown 13 cm plants were, as in 1995, essentially of as high a quality as control plants. Although plants were generally rather short in 1996, week 28 cool-grown plants were at least as tall as the controls, and all except Red Sails were of comparable plant diameter. Cool temperature had no adverse effect on bract star number, but bract size was reduced in Ria and Sonora, as found in 1995. Cool growing tended to accelerate bract colouring and cyathia development.

Closer spacing had no deleterious effects either on the height or the diameter of week 28 cool-grown plants, but tended to reduce bract star size in cultivar Ria. Overall, average plant quality was judged to have been as good at the higher spacing as at the lower spacing, except for Ria grown shaded. Thus, there would appear to be considerable scope for increasing plant densities and throughput per unit area. However, this conclusion must be viewed with caution since plants generally were relatively small in 1996, and greater vigour might have resulted in greater plant competition and an adverse effect of closer spacing on quality.

The light climate in 1996 was similar to that in 1995, so extrapolations of the findings to more northerly locations is best done by considering the effects of shading. Shading slightly reduced plant height and diameter in week 28 cool-grown Ria, but not in Freedom or Sonora (Red Sails was not grown in a shaded treatment). It did, however, cause a larger and more general reduction in bract star size. Overall, mean plant quality tended to be reduced by shading in all three cultivars, with the effect being most marked in Ria grown at high density. Thus, it seems likely that cool growing would require a rather longer compensatory period of growth (prior to normal 'warm' potting date) for the practice to be successful in northerly parts of Britain.

As in 1995, higher relative humidities accompanying lower temperatures did not noticeably increase the incidence of *Botrytis*.

Cool growing had no adverse effect on shelf life in 1995, but gave mixed results in 1996. Thus, overall performance was improved by prior cool-growing in Ria, but was reduced in Sonora and Red Sails, by encouraging earlier leaf and bract drop and accelerating colour fading. It is not clear why results should differ between years and between cultivars. Commercially cool-grown plants of Red Sails also showed greater leaf and bract loss during shelf life. Sleeving, both in the Efford trials and in commercially grown Red Sails, had little obvious effect on shelf life in general, although it did appear to increase early leaf loss of cool-grown Freedom plants.

Given that cool growing (with earlier potting date) can give commercially acceptable poinsettias, the question remains as to potential benefits. The most obvious benefit of cool growing, so long as the requirement for a longer crop time fits in with the annual cropping cycle, is reduced energy use. This was calculated in the Year 1 Report using the computer program, Horticern, and the savings were expressed in terms of litres/m^2 heating oil equivalent. Based on long-term average weather conditions for London, and the characteristics of the greenhouse used for the trials at Efford, the theoretical energy saving from cool growing equated to 15.8 litres/m^2 oil (569 MJ/m^2) when thermal screens were not used, and 13.7 litres/m^2 oil (493 MJ/m^2) when thermal screens were used. These savings amounted to 39% and 41% respectively.

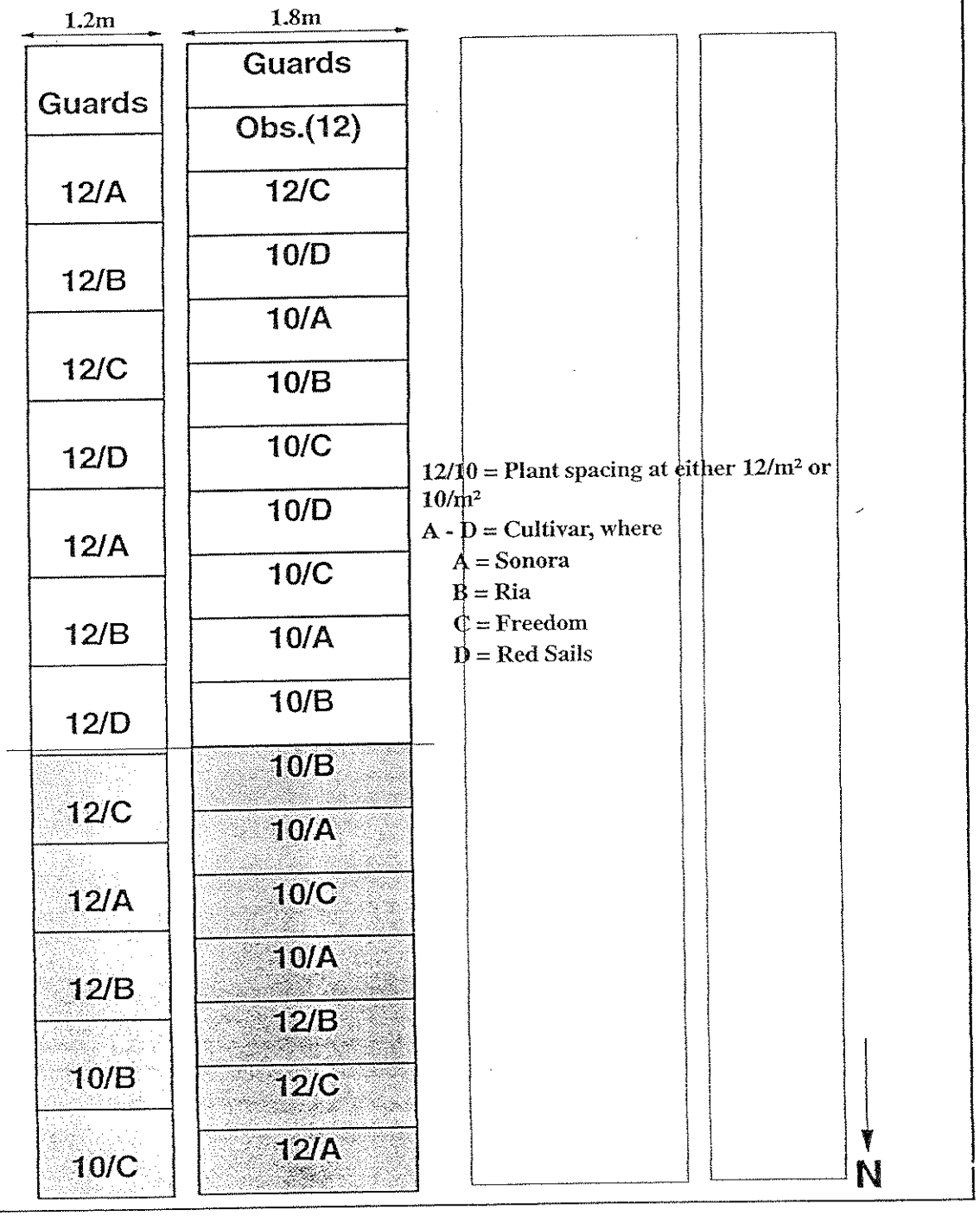
This exercise was repeated in 1996, but based on expectations for a large, modern (0.25 hectare) block sited either in the south of England (Lymington) or the north of England (Boston). Although the energy inputs required to maintain the two growing regimes were higher for the northern site, the potential savings due to cool growing proved almost identical. Thus, cool growing can be expected to save the equivalent of about 7 litres/m^2 oil where screens are not used, and about 6 litres/m^2 oil where screens are used. These figures are rather smaller than those calculated in the Year One Report (see above) since these latter were based on the use of a much smaller glasshouse. Growing in a commercial glasshouse smaller than 0.25 hectares can be expected to give potential savings lying between the two sets of figures.

The second potential benefit of cool growing is a reduction in total cycocel used to regulate growth, and in numbers of cycocel applications. Thus, in 1995, there was a saving of 62% in total cycocel used for the week 30 cool crop, compared to the same week potted control crop (averaged over all 10 cultivars). However, since earlier potting appeared necessary to achieve comparable quality, better comparisons of use are between the week 28 cool crop and the week 30 warm crop, where the saving due to lower temperature was 9%, and between the week 30 cool crop and the week 32 warm crop, where the saving was 45%. Crops tended to be rather less vigorous in 1996, and overall growth regulator application was reduced to below that in 1995 by 39%. Presumably as a result of this, cooler cropping in 1996 did not give a saving in growth regulator use. Averaging over cultivars, a one-week earlier potting for cool-grown pots gave no reduction, and a 3-week earlier potting actually increased the total applied by 10%. Of the four cultivars grown in 1996, Freedom was the only one where cooler growing allied to three weeks earlier potting, reduced cycocel use (by 7%) and the only one showing substantial savings in growth regulator use when potting was just one week earlier (20%). The number of cycocel applications needed to control growth in the week 28 cool crop was also increased by up to 3, depending on cultivar, so there was no benefit from reduced labour inputs.

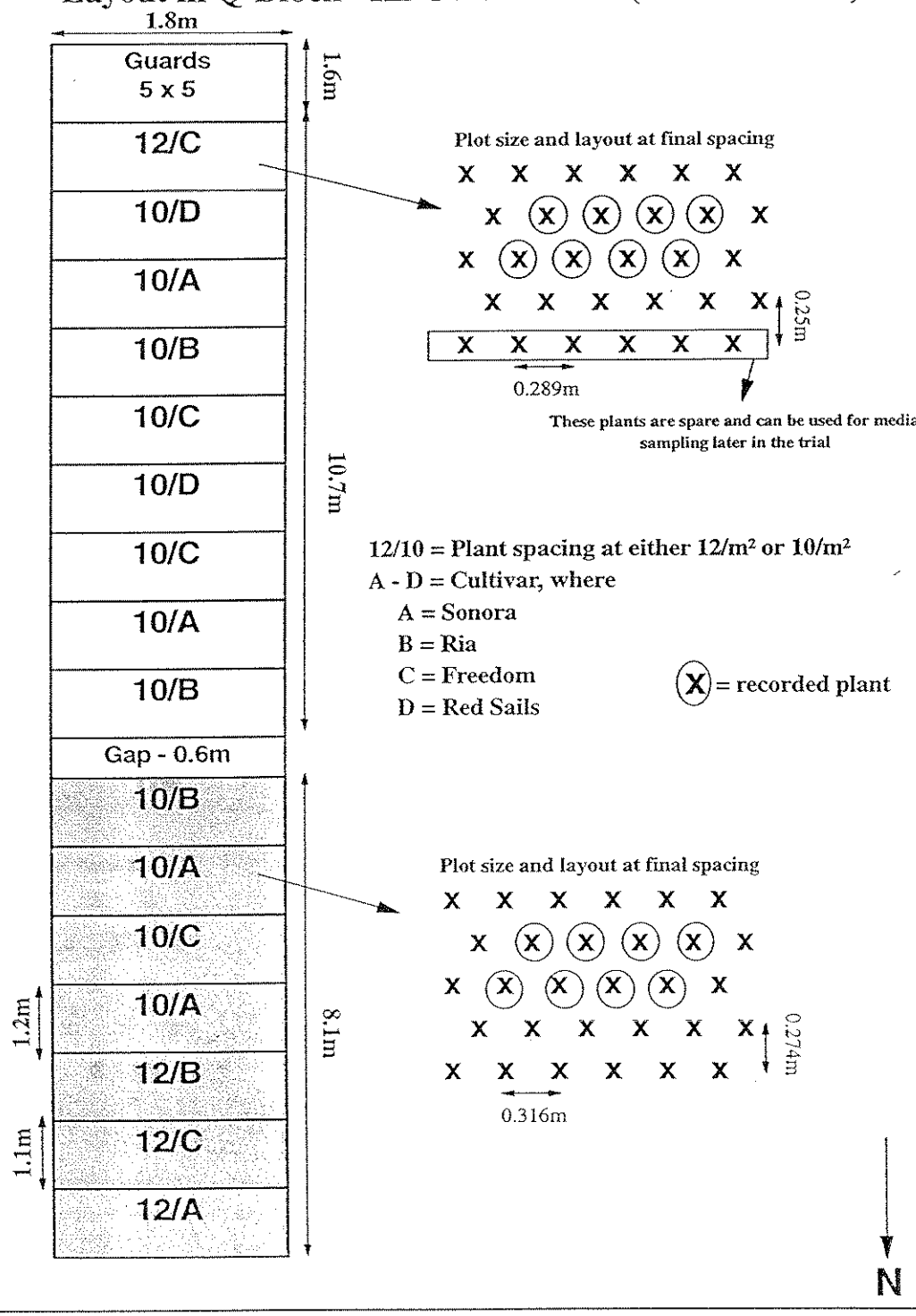
A major feature of the first year of the project was a comparison of 26 new cultivars grown at Efford under standard commercial conditions, and 11 new cultivars grown on four commercial nurseries. All cultivars grown at Efford and cultivar samples from two of the commercial sites were subsequently evaluated for shelf life at Efford. Full details of the performance of the new cultivars are given in the Year 1 Report, but cultivars singled out as being of particularly high quality at marketing were Eda Rose and Noblestar. Best quality scores in shelf life were assigned to Spotlight Crimson, Success, Lilo Marble and Dynasty Red. New cultivar evaluations in 1996 were confined to 10 (including controls) grown on four commercial nurseries, and descriptions and performance of these are recorded in this Report.

APPENDIX I: EXPERIMENTAL LAYOUT

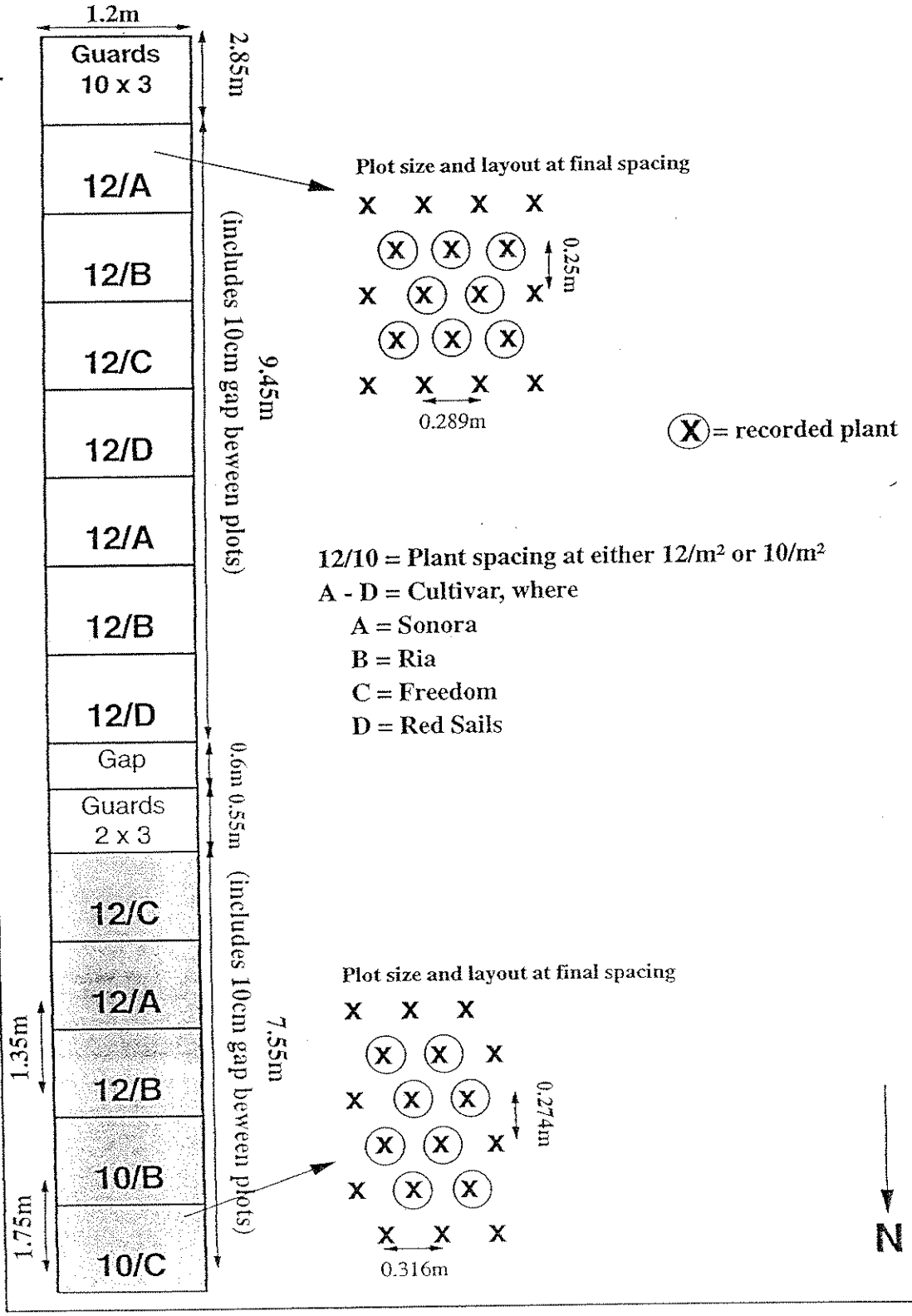
Layout in Q-Block - HDC Poinsettias (GLP No. 1045)



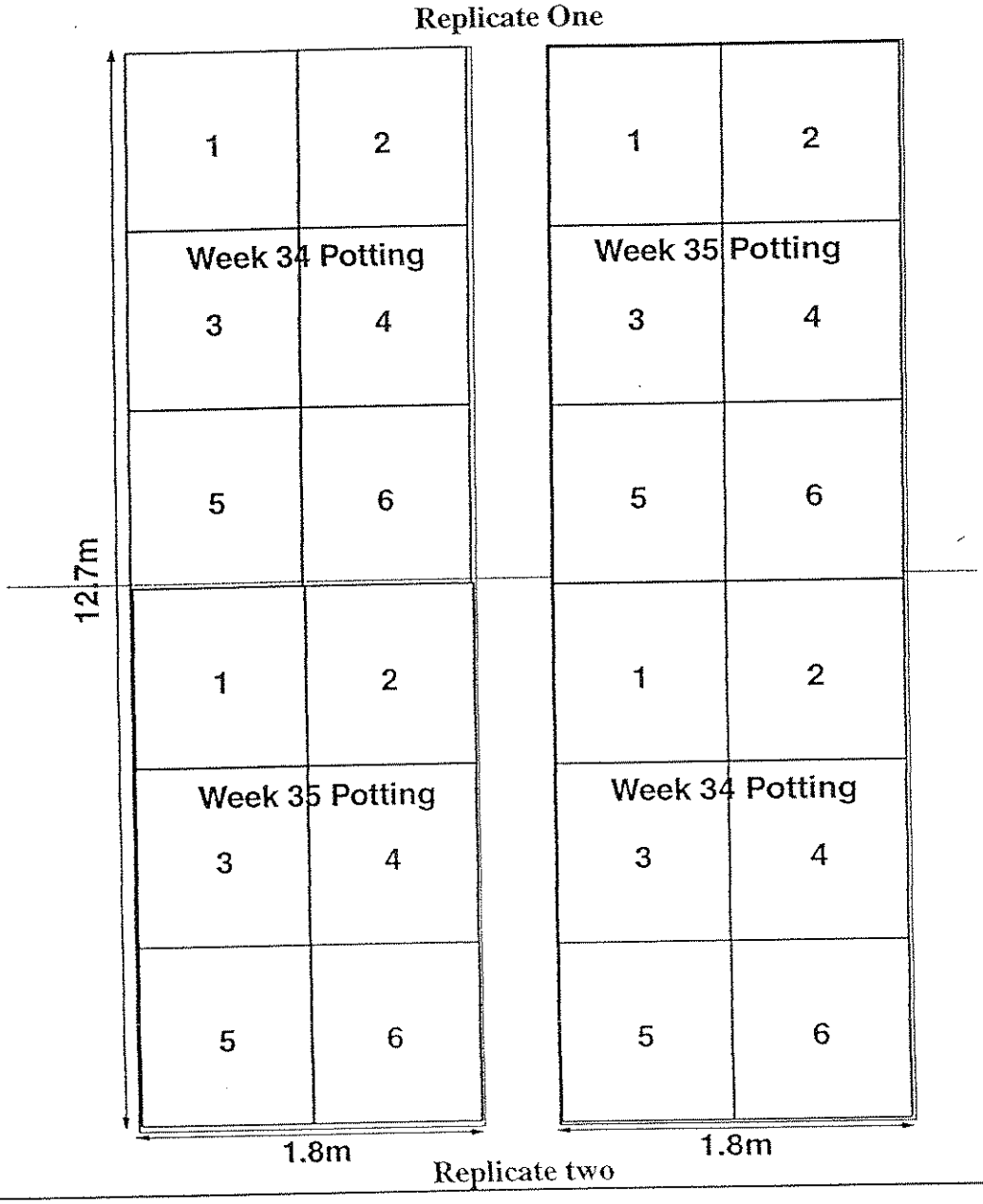
Layout in Q-Block - HDC Poinsettias (GLP No. 1045)



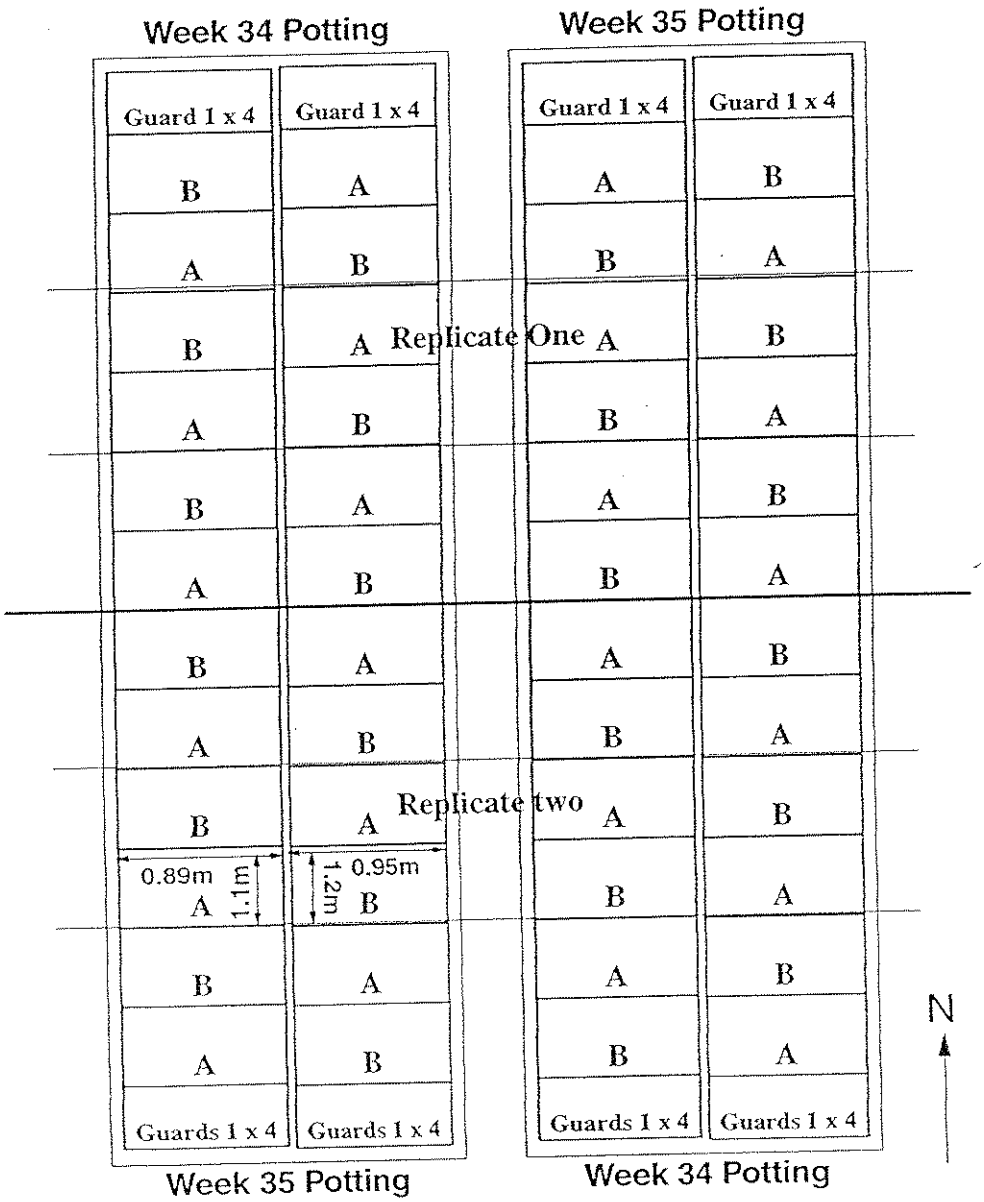
Layout in Q-Block - HDC Poinsettias (GLP No. 1045)



H-Block North Plant Layout for Poinsettias (GLP No.1045)

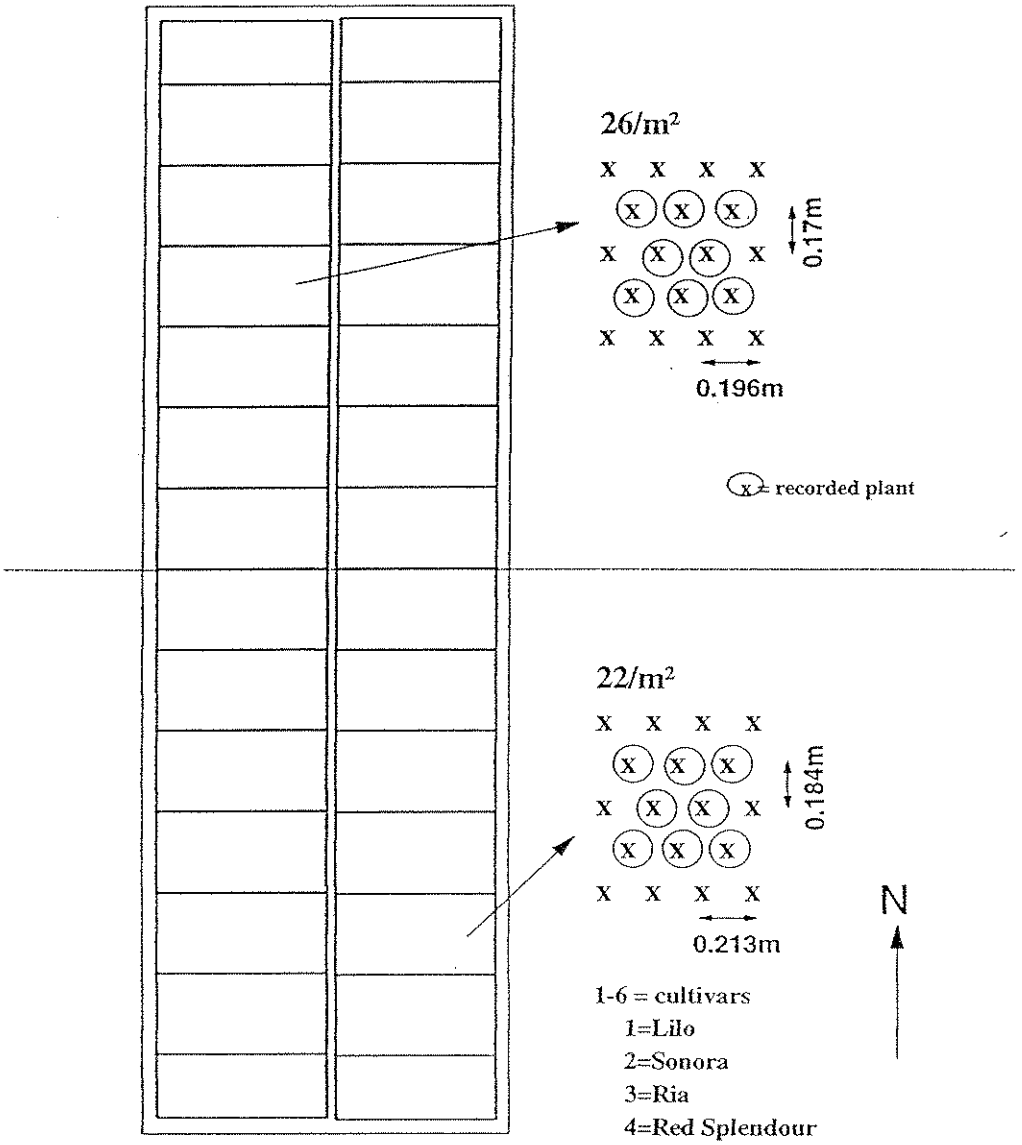


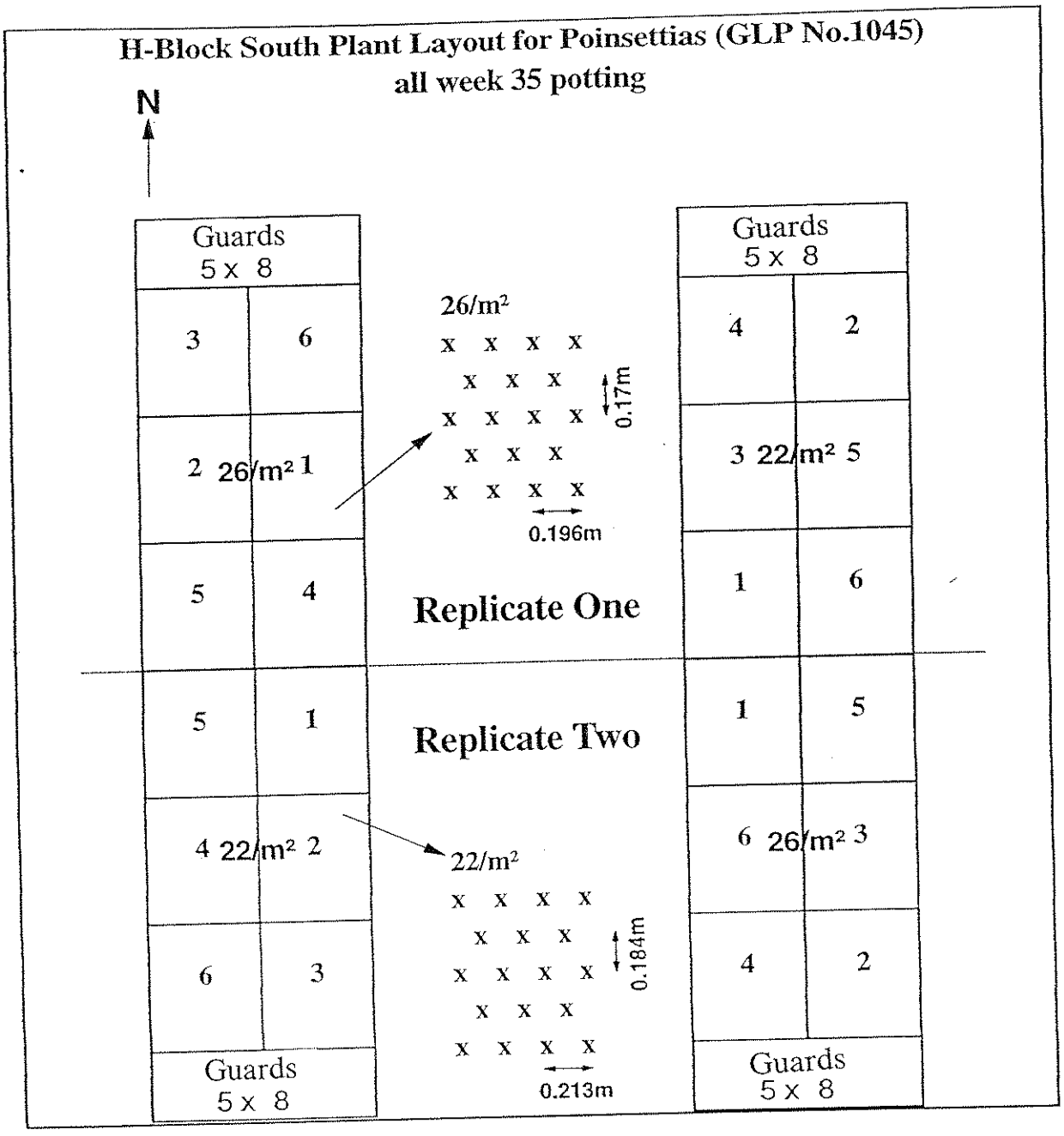
H-Block North Plant Layout for Poinsettias (GLP No.1045)



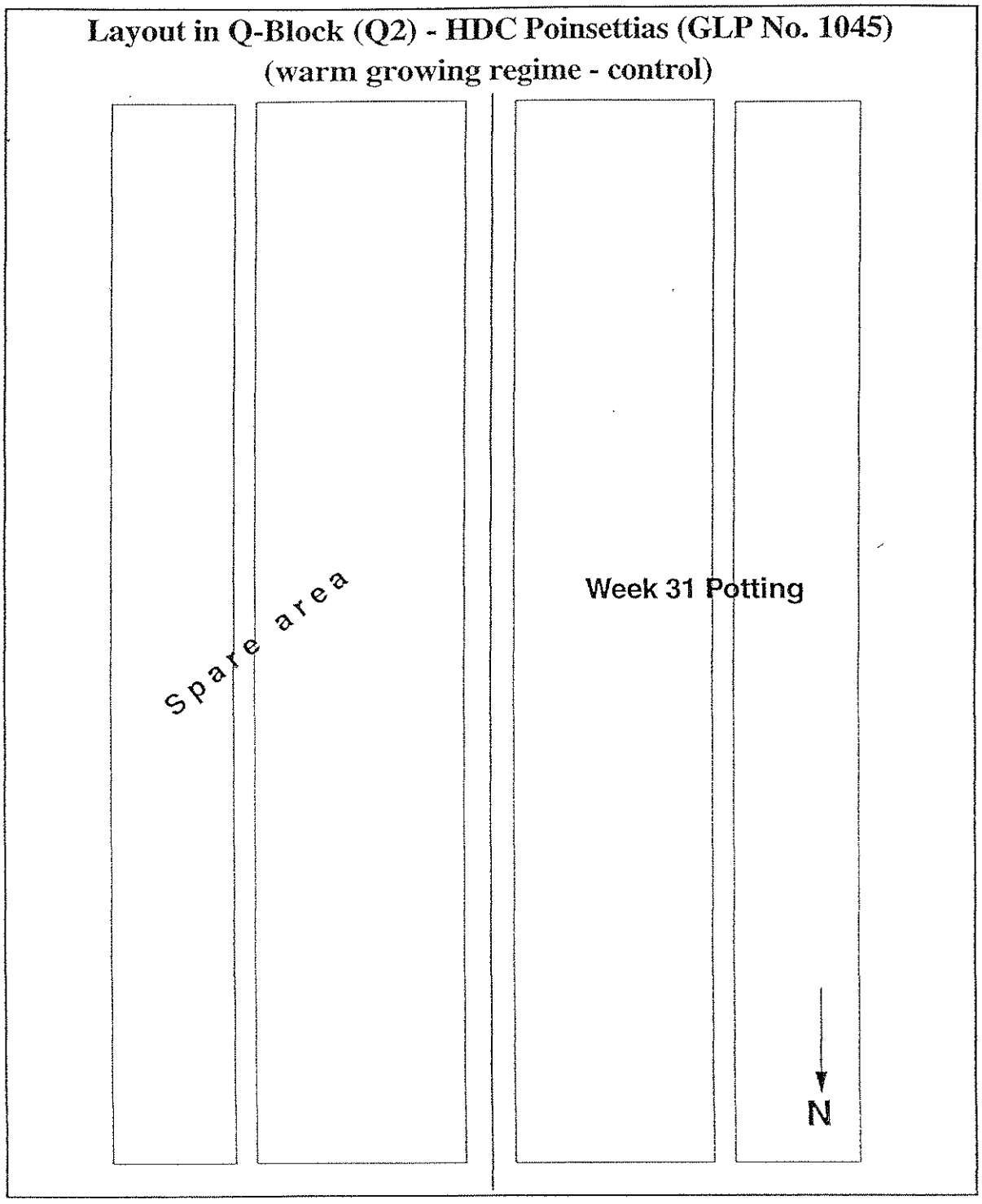
A = 26/m² B = 22/m²

H-Block North Plant Layout for Poinsettias (GLP No.1045)

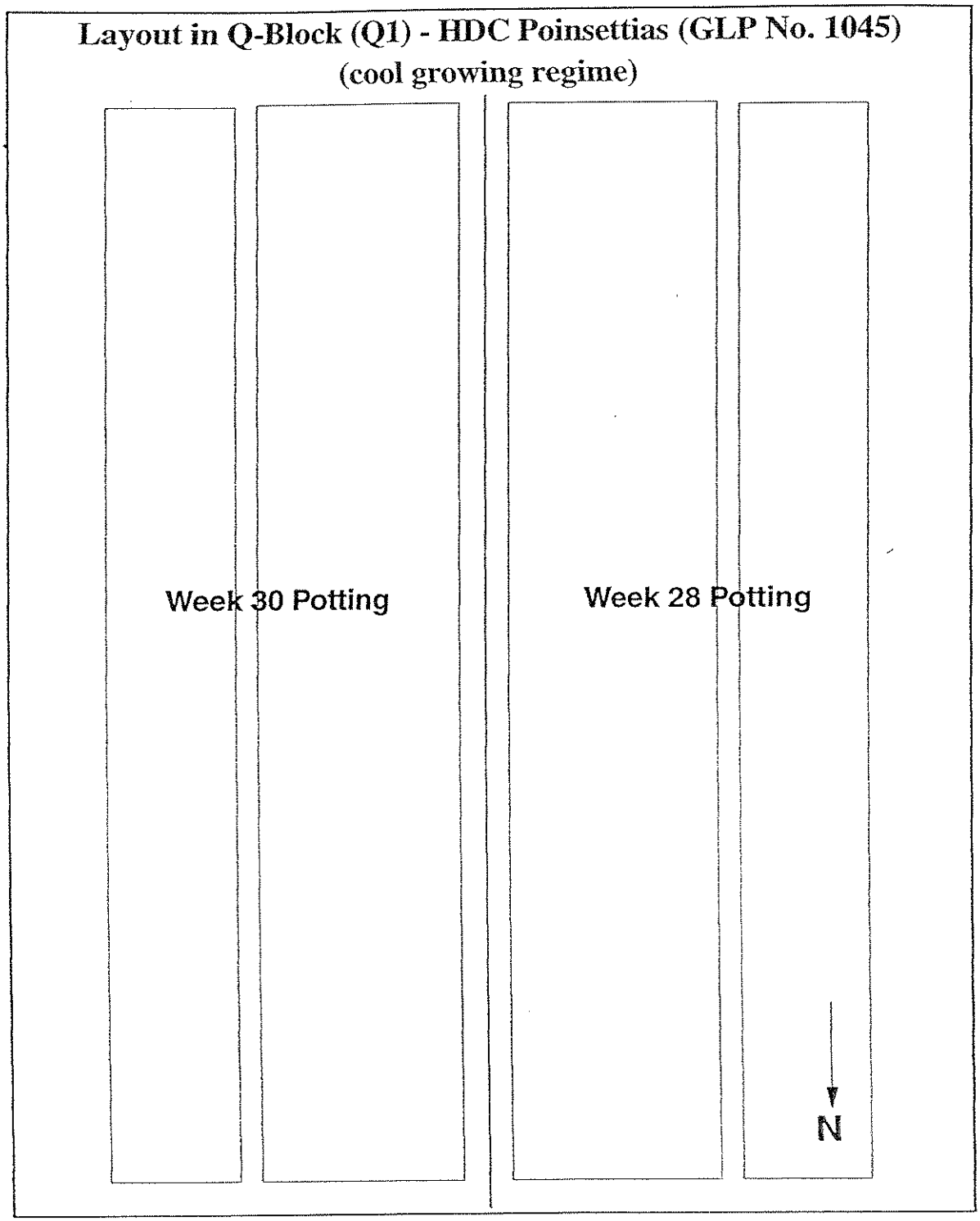



H-Block South Plant Layout for Poinsettias (GLP No.1045)
all week 35 potting
N
Guards 5 x 8
3
6
2 26/m² 1
5
4
5
1
4 22/m² 2
6
3
Guards 5 x 8
26/m²
0.17m
0.196m
Replicate One
Replicate Two
22/m²
0.184m
0.213m
Guards 5 x 8
4
2
3 22/m² 5
1
6
1
5
6 26/m² 3
4
2
Guards 5 x 8

Layout in Q-Block (Q2) - HDC Poinsettias (GLP No. 1045)
(warm growing regime - control)



Layout in Q-Block (Q1) - HDC Poinsettias (GLP No. 1045)
(cool growing regime)



APPENDIX II: CROP DIARY

Q1 WK 28 COOL

		RED SAILS	SONORA
Wk 28	potted 13 cm pots	12/7	12/7
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 30	stopped to 6 leaves	22/7	
	stopped to 5 leaves		22/7
	started feeding	23/7	23/7
	calcium nitrate 150 ppm N pH 6.0		
	started reducing temperatures by 1 ° steps		
	to establish cool regime		
	19 °C D/N 21 °C D/N vent	25/7	25/7
	increased shade screen threshold 300 Wm^{-2}		
	unshaded plots removed second layer of fleece		
	18 °C D/N 20 °C D/N vent	26/7	26/7
Wk 31	17 °C D/N 19 °C D/N vent	29/7	29/7
	removed all remaining fleece		
	16 °C D/N 18 °C D/N vent	30/7	30/7
	15 °C D/N 17 °C D/N vent	31/7	31/7
	cool regime established		
Wk 32	spaced	5/8	5/8
Wk 33	spacing 25 pots m^{-2}	13/8	13/8
	started early season feed	14/8	14/8
	225 ppm N 25 ppm P 150 ppm K pH 6.0		
	increased shade screen threshold 400 Wm^{-2}	16/8	16/8
Wk 34	increased shade screen threshold 500 Wm^{-2}	22/8	22/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced		6/9
Wk 38	increased temperatures to counteract stunting		
	due to Basilex drench		
	16 °C D/N 18 °C D/N vent	16/9	16/9
	Final spacing 12 pots m^{-2} 10 pots m^{-2}	20/9	20/9
	(according to treatments)		
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		

Q1 WK 28 COOL

		FREEDOM	RIA
Wk 28	potted 13 cm pots	12/7	12/7
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 30	stopped to 6 leaves	22/7	
	stopped to 5 leaves		22/7
	started feeding	23/7	23/7
	calcium nitrate 150 ppm N pH 6.0		
	started reducing temperatures by 1 ° steps to establish cool regime		
	19 °C D/N 21 °C D/N vent	25/7	25/7
	increased shade screen threshold 300 Wm^{-2}		
	unshaded plots removed second layer of fleece		
	18 °C D/N 20 °C D/N vent	26/7	26/7
Wk 31	17 °C D/N 19 °C D/N vent	29/7	29/7
	removed all remaining fleece		
	16 °C D/N 18 °C D/N vent	30/7	30/7
	15 °C D/N 17 °C D/N vent	31/7	31/7
	cool regime established		
Wk 32	spaced	5/8	5/8
Wk 33	spacing 25 pots m^{-2}	13/8	13/8
	started early season feed	14/8	14/8
	225 ppm N 25 ppm P 150 ppm K pH 6.0		
	increased shade screen threshold 400 Wm^{-2}	16/8	16/8
Wk 34	increased shade screen threshold 500 Wm^{-2}	22/8	22/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced		6/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	16 °C D/N 18 °C D/N vent	16/9	16/9
	Final spacing 12 pots m^{-2} 10 pots m^{-2} (according to treatments)	20/9	20/9
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		

Q1 WK 30 COOL

		RED SAILS	SONORA
Wk 30	potted 13 cm pots	24/7	24/7
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 31	stopped to 6 leaves	1/8	
	stopped to 5 leaves		1/8
	started feeding	1/8	1/8
	calcium nitrate 150 ppm N pH 6.0		
Wk 32	increased shade screen threshold 300 Wm^{-2}	6/8	6/8
	unshaded plots removed second layer of fleece	7/8	7/8
	removed all remaining fleece		8/8
Wk33	removed all remaining fleece	12/8	
	15 °C D/N 17 °C D/N vent	14/8	12/8
	transferred from Q2 to Q1		
	cool regime established		
	spaced		13/8
	increased shade screen threshold 400 Wm^{-2}		16/8
Wk 34	15 °C D/N 17 °C D/N vent		
	transferred from Q2 to Q1		
	cool regime established		
	started early season feed	20/8	20/8
	225 ppm N 25 ppm P 150 ppm K pH 6.0		
	increased shade screen threshold 500 Wm^{-2}	22/8	22/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced	1/9	
	increased shade screen threshold 600 Wm^{-2}	2/9	2/9
Wk 37	spacing 25 pots m^{-2}	10/9	10/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	16 °C D/N 18 °C D/N vent	16/9	16/9
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		
Wk 45	Final spacing 12 pots m^{-2} 10 pots m^{-2} (according to treatments)	8/10	8/10

Q1 WK 30 COOL

		FREEDOM	RIA
Wk 30	potted 13 cm pots	24/7	25/7
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 31	calcium nitrate 150 ppm N pH 6.0	1/8	1/8
Wk 32	stopped to 6 leaves	5/8	
	stopped to 5 leaves		5/8
	increased shade screen threshold 300 Wm^{-2}	6/8	6/8
	unshaded plots removed second layer of fleece	7/8	7/8
	removed all remaining fleece		8/8
Wk33	removed all remaining fleece	15/8	12/8
	15 °C D/N 17 °C D/N vent		14/8
	transferred from Q2 to Q1		
	cool regime established		
	spaced		13/8
	increased shade screen threshold 400 Wm^{-2}		16/8
Wk 34	15 °C D/N 17 °C D/N vent	19/8	
	transferred from Q2 to Q1		
	cool regime established		
	started early season feed	20/8	20/8
	225 ppm N 25 ppm P 150 ppm K pH 6.0		
	increased shade screen threshold 500 Wm^{-2}	22/8	22/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced	1/9	
	increased shade screen threshold 600 Wm^{-2}	2/9	2/9
Wk 37	spacing 25 pots m^{-2}	10/9	10/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	16 °C D/N 18 °C D/N vent	16/9	16/9
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		
Wk 45	Final spacing 12 pots m^{-2} 10 pots m^{-2}	8/10	8/10
	(according to treatments)		

Q2 WK 31 WARM CONTROL

		RED SAILS	SONORA
Wk 31	potted 13 cm pots	31/7	31/7
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 32	calcium nitrate 150 ppm N pH 6.0	5/8	5/8
	increased shade screen threshold 300 Wm^{-2}	6/8	6/8
Wk 33	stopped to 6 leaves	12/8	
	stopped to 5 leaves		12/8
	unshaded plots removed second layer of fleece	13/8	13/8
Wk34	removed all remaining fleece	20/8	20/8
	increased shade screen threshold 350 Wm^{-2}	22/8	22/8
Wk 35	increased shade screen threshold 400 Wm^{-2}	29/8	29/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced	1/9	
	increased shade screen threshold 600 Wm^{-2}	2/9	2/9
Wk 37	spaced	10/9	10/9
	19 °C D/N 21 °C D/N vent	11/9	11/9
	18 °C D/N 20 °C D/N vent	13/9	13/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	19 °C D/N 21 °C D/N vent	16/9	16/9
	spacing 20 pots m^{-2}	18/9	18/9
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 $g\,l^{-1}$ @ 1 : 100		
	Ca EDTA 5 $g\,l^{-1}$ @ 1 : 100		
Wk 43	Final spacing 12 pots m^{-2} 10 pots m^{-2} (according to treatments)	21/10	21/10

Q2 WK 31 WARM CONTROL

		FREEDOM	RIA
Wk 31	potted 13 cm pots	31/7	1/8
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 59 pots m^{-2}		
	single layer fleece		
	double layer fleece on unshaded plots		
	shade screen threshold 200 Wm^{-2}		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 32	calcium nitrate 150 ppm N pH 6.0	5/8	5/8
	increased shade screen threshold 300 Wm^{-2}	6/8	6/8
Wk 33	stopped to 6 leaves	12/8	
	stopped to 5 leaves		14/8
	unshaded plots removed second layer of fleece	13/8	13/8
Wk34	removed all remaining fleece	20/8	20/8
	increased shade screen threshold 350 Wm^{-2}	22/8	22/8
Wk 35	increased shade screen threshold 400 Wm^{-2}	29/8	29/8
Wk 36	stopped all feed due to high ammonia levels	1/9	1/9
	spaced	1/9	
	increased shade screen threshold 600 Wm^{-2}	2/9	2/9
Wk 37	spaced	10/9	10/9
	19 °C D/N 21 °C D/N vent	11/9	11/9
	18 °C D/N 20 °C D/N vent	13/9	13/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	19 °C D/N 21 °C D/N vent	16/9	16/9
	spacing 20 pots m^{-2}	18/9	18/9
Wk 39	reduced temperatures post Basilex drench	23/9	23/9
	15 °C D/N 22 °C D vent 17 ° C N vent		
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 $g\,l^{-1}$ @ 1 : 100		
	Ca EDTA 5 $g\,l^{-1}$ @ 1 : 100		
Wk 43	Final spacing 12 pots m^{-2} 10 pots m^{-2} (according to treatments)	21/10	21/10

H WK 34 COOL

		FREEDOM	RIA
Wk 34	potted 10 cm pots	20/8	21/8
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 100 pots m^{-2}		
	single layer fleece		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 35	calcium nitrate 150 ppm N pH 6.0	29/8	29/8
	stopped to 5 leaves		29/8
Wk 36	stopped to 5 leaves	3/9	
	stopped all feed due to high ammonia levels	3/9	3/9
Wk 37	removed all fleece	9/9	9/9
	started reducing temperatures by 1° steps to establish cool regime		
	19 °C D/N 21 °C D/N vent	11/9	11/9
	removed permanent shading	12/9	12/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	20 °C D/N 22 °C D/N vent	16/9	16/9
	spaced	20/9	20/9
Wk 39	reduced temperatures post Basilex drench		
	19 °C D/N 21 °C D/N vent	23/9	23/9
	18 °C D/N 20 °C D/N vent	25/9	25/9
	17 °C D/N 19 °C D/N vent	26/9	26/9
	spacing 39 pots m^{-2}	26/9	26/9
	16 °C D/N 18 °C D/N vent	27/9	27/9
	15 °C D/N 22 °C D vent 17 °C N vent	29/9	29/9
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		
Wk 41	stopped feeding post analysis results	7/10	7/10
Wk 43	restarted main season feed	22/10	22/10
Wk 45	final spacing 22 pots m^{-2} 26 pots m^{-2}	8/11	8/11

H WK 35 COOL

		RED SPLENDOUR	SONORA	CORTEZ
Wk 35	potted 10 cm pots	29/8	29/8	29/8
	Bulrush pointsettia compost (peat + 20% bark)			
	spacing 100 pots m^{-2}			
	single layer fleece			
	temperatures 20 °C D/N 22 °C D/N vent			
Wk 36	stopped to 5 leaves	3/9	3/9	4/9
Wk 37	removed all fleece	9/9	9/9	9/9
	removed permanent shading	12/9	12/9	12/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench			
	21 °C D/N 22 °C D/N vent	16/9	16/9	16/9
Wk 39	reduced temperatures post Basilex drench			
	19 °C D/N 21 °C D/N vent	23/9	23/9	23/9
	transferred to H north	23/9	23/9	23/9
	18 °C D/N 20 °C D/N vent	25/9	25/9	25/9
	17 °C D/N 19 °C D/N vent	26/9	26/9	26/9
	spacing 39 pots m^{-2}	26/9	26/9	26/9
	16 °C D/N 18 °C D/N vent	27/9	27/9	27/9
	15 °C D/N 22 °C D vent 17 °C N vent	29/9	29/9	29/9
Wk 40	started main season feed - alternate waterings	2/10	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg			
	+ Librel BMX 10 g l^{-1} @ 1 : 100			
	Ca EDTA 5 g l^{-1} @ 1 : 100			
Wk 41	stopped feeding post analysis results	7/10	7/10	7/10
Wk 43	restarted main season feed	22/10	22/10	22/10
Wk 45	final spacing 22 pots m^{-2} 26 pots m^{-2}	8/11	8/11	8/11

H WK 35 COOL

		FREEDOM	RIA
Wk 35	potted 10 cm pots	29/8	29/8
	Bulrush pointsettia compost (peat + 20% bark)		
	spacing 100 pots m^{-2}		
	single layer fleece		
	temperatures 20 °C D/N 22 °C D/N vent		
Wk 36	stopped to 5 leaves	3/9	
Wk 37	removed all fleece	9/9	9/9
	removed permanent shading	12/9	12/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	21 °C D/N 22 °C D/N vent	16/9	16/9
Wk 39	reduced temperatures post Basilex drench		
	19 °C D/N 21 °C D/N vent	23/9	23/9
	transferred to H north	23/9	23/9
	18 °C D/N 20 °C D/N vent	25/9	25/9
	17 °C D/N 19 °C D/N vent	26/9	26/9
	spacing 39 pots m^{-2}	26/9	26/9
	16 °C D/N 18 °C D/N vent	27/9	27/9
	15 °C D/N 22 °C D vent 17 °C N vent	29/9	29/9
Wk 40	started main season feed - alternate waterings	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg		
	+ Librel BMX 10 g l^{-1} @ 1 : 100		
	Ca EDTA 5 g l^{-1} @ 1 : 100		
Wk 41	stopped feeding post analysis results	7/10	7/10
Wk 43	restarted main season feed	22/10	22/10
Wk 45	final spacing 22 pots m^{-2} 26 pots m^{-2}	8/11	8/11

H WK 35 WARM CONTROL

		RED SPLENDOUR	SONORA	CORTEZ
Wk 35	potted 10 cm pots	29/8	29/8	29/8
	Bulrush pointsettia compost (peat + 20% bark)			
	spacing 100 pots m^{-2}			
	single layer fleece			
	temperatures 20 °C D/N 22 °C D/N vent			
Wk 36	stopped to 5 leaves	3/9	3/9	4/9
Wk 37	removed all fleece	9/9	9/9	9/9
	removed permanent shading	12/9	12/9	12/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench			
	21 °C D/N 22 °C D/N vent	16/9	16/9	16/9
Wk 39	reduced temperatures post Basilex drench			
	20 °C D/N 21 °C D/N vent	23/9	23/9	23/9
	spacing 39 pots m^{-2}	26/9	26/9	26/9
Wk 40	started main season feed - alternate waterings	2/10	2/10	2/10
	200 ppm N 40 ppm P 180 ppm K 40 ppm Mg			
	+ Librel BMX 10 g l^{-1} @ 1 : 100			
	Ca EDTA 5 g l^{-1} @ 1 : 100			
Wk 41	stopped feeding post analysis results	7/10	7/10	7/10
Wk 43	restarted main season feed	22/10	22/10	22/10
	final spacing 22 pots m^{-2} 26 pots m^{-2}	23/10	23/10	23/10

H WK 35 WARM CONTROL

		FREEDOM	RIA
Wk 35	potted 10 cm pots Bulrush pointsettia compost (peat + 20% bark) spacing 100 pots m^{-2} single layer fleece temperatures 20 °C D/N 22 °C D/N vent	29/8	29/8
Wk 36	stopped to 5 leaves	3/9	3/9
Wk 37	removed all fleece	9/9	9/9
	removed permanent shading	12/9	12/9
Wk 38	increased temperatures to counteract stunting due to Basilex drench		
	21 °C D/N 22 °C D/N vent	16/9	16/9
Wk 39	reduced temperatures post Basilex drench		
	20 °C D/N 21 °C D/N vent	23/9	23/9
	spacing 39 pots m^{-2}	26/9	26/9
Wk 40	started main season feed - alternate waterings 200 ppm N 40 ppm P 180 ppm K 40 ppm Mg + Librel BMX 10 g l^{-1} @ 1 : 100 Ca EDTA 5 g l^{-1} @ 1 : 100	2/10	2/10
Wk 41	stopped feeding post analysis results	7/10	7/10
Wk 43	restarted main season feed	22/10	22/10
	final spacing 22 pots m^{-2} 26 pots m^{-2}	23/10	23/10

PEST & DISEASE CONTROL		28	30	31	34	35	35(cool)
wk 30	Encarsia formosa	25/7	25/7				
wk 31	Rovral g l - 1		31/7				
wk 32	EXHIBIT SF-WDG	7/8	7/8	7/8			
	500,000 nematodes m - 2						
	drench 50 ml/pot						
	Encarsia formosa	8/8	8/8	8/8			
wk 34	Encarsia formosa	27/8	27/8	27/8	27/8		
wk 36	Nemolt spray	2/9	2/9	2/9			
	0.5 ml l - 1						
	Rovral g l - 1				4/9	4/9	4/9
	Fongarid drench	4/9					
	5 g m - 2						
	Sonora						
wk 37	Fongarid drench	10/9	10/9	10/9	10/9	10/9	10/9
	5 g m - 2						
	except Sonora wk28						
wk 38	Basilex/Filex drench	16/9	16/9	16/9	16/9	16/9	16/9
	combined drench						
	Filex 10 ml m - 2						
	70 ml/10 cm pot						
	100 ml/13 cm pot						
	Basilex 2 g m - 2						
	70 ml/10 cm pot						
	100 ml/13 cm pot						
	Nemolt drench	19/9	19/9	19/9	19/9	19/9	19/9
	0.5 ml l - 1						
	70 ml/10 cm pot						
	100 ml/13 cm pot						
wk 39	Encarsia formosa	26/9	26/9	26/9	26/9	26/9	26/9
wk 41	Encarsia formosa	10/10	10/10	10/10	10/10	10/10	10/10
wk 43	Nemolt drench				21/10	21/10	21/10
	0.5 ml l - 1						
	70 ml/10 cm pot						
wk 44	Encarsia formosa	29/10	29/10	29/10	29/10	29/10	29/10

CYCOCEL APPLICATIONS

RED SAILS

wk	date	rate	28 (cool)	30 (cool)	31 (standard)
30					
31*	30/7	1.0 ml l^{-1}	1		
32					
33*	12/8		2		
	14/8		3	1	
	17/8		4		
34	20/8		5	2	
	22/8		6	3	
	24/8		7	4	1
35	29/8		8	5	2
36	3/9	0.5 ml l^{-1}	9	6	3 (1.0)
37	11/9		10	7 (1.0)	4 (1.0)
38*	17/9		11	8 (1.0)	5 (1.0)
	20/9			9 (1.0)	6 (1.0)
39	25/9		12	10 (1.0)	7
40	1/10		13	11	8 (1.0)
41	7/10	1.0 ml l^{-1}	14		9
42	18/10		15	12	10
43	21/10				11
	23/10		16	13	12
44	29/10				13

31* 28 (cool) established cool regime

33* 30(cool) transferred Q2 to Q1 to start cool temperature regime

RIA

wk	date	rate	28 (cool)	30 (cool)	31 (standard)
30					
31*	30/7	1.0 ml l^{-1}	1		
32	9/8		2		
33*	12/8		3	1	
	17/8		4		
34	20/8		5		
	22/8		6	2	
	24/8				1
35	29/8			3	2
36	3/9	0.5 ml l^{-1}	7	4	3
37	11/9		8	5 (1.0)	4 (1.0)
38*	17/9		9	6 (1.0)	5 (1.0)
	20/9			7 (1.0)	6 (1.0)
39	25/9		10	8 (1.0)	7 (1.0)
40	1/10		11	9	8
41	7/10	1.0 ml l^{-1}	12	10	9
42	18/10		13	11	10
43	23/10		14	12	11

31* 28 (cool) established cool regime

33* 30(cool) transferred Q2 to Q1 to start cool temperature regime

SONORA

wk	date	rate	28 (cool)	30 (cool)	31 (standard)
30	26/7	1.0 ml l^{-1}	1		
31*					
32	9/8			1	
33*	17/8		2		
34	20/8		3		
	22/8			2	1
35					
36	3/9	0.5 ml l^{-1}	4	3	2
37	11/9		5	4 (1.0)	3 (1.0)
38*	17/9				4 (1.0)
39	25/9		6	5 (1.0)	5
40	1/10		7	6	6
41	7/10	1.0 ml l^{-1}	8	7	
42	18/10		9	8 (0.5)	7
43	23/10		10	9	8

31* 28 (cool) established cool regime

33* 30(cool) transferred Q2 to Q1 to start cool temperature regime

	wk	date	rate	28 (cool)	30 (cool)	31 (standard)
FREEDOM						
	30					
	31					
	32					
	33	12/8	1.0 ml l^{-1}	1		
		14/8		2		
	34*	20/8		3	1	
		24/8				1
	35					
	36	3/9	0.5 ml l^{-1}	4	2	2
	37	11/9		5	3 (1.0)	3 (1.0)
	38	17/9	1.0 ml l^{-1}			4
	39	25/9	0.5 ml l^{-1}	6	4 (1.0)	5
	40	1/10		7	5	6
	41					
	42	18/10	1.0 ml l^{-1}	8	6	7
	43	21/10				8
		23/10		9	7	9

31* 28 (cool) established cool regime

34* 30 (cool) transferred Q2 to Q1 to start cool temperature regime

CORTEZ

wk	date	rate	34(cool)	35(cool)	35(standard)
37*	11/9	1.0 ml l^{-1}	1		
38	17/9		2	1	1
	20/9		3	2	2
39*	25/9		4	3	3
40	30/9		5	4	4
	2/10		6	5	5
41	7/10		7	6	6
	9/10		8	7	7
42	16/10		9	8	8
	18/10		10		9
43	21/10		11	9	10
	23/10				11

37* 34 (cool) established cool regime

39* 35 (cool) transferred H south to H north to start cool temperature regime

SONORA

wk	date	rate	34(cool)	35 (cool)	35 (standard)
37*	11/9	1.0 ml l^{-1}	1		
38	17/9		2	1	1
	20/9		3	2	2
39*	25/9		4	3	3
40	30/9		5	4	4
	2/10		6	5	5
41	7/10		7	6	6
	9/10		8	7	7
42	16/10		9	8	8
	18/10		10		9
43	21/10		11	9	10
	23/10				11

37* 34 (cool) established cool regime

39* 35 (cool) transferred H south to H north to start cool temperature regime

RIA

wk	date	rate	34(cool)	35(cool)	35(standard)
37*	11/9	1.0 ml l^{-1}	1		
38	17/9		2	1	1
	20/9		3	2	2
39*	25/9		4	3	3
40	30/9		5	4	4
	2/10		6	5	5
41	7/10		7	6	6
	9/10		8	7	7
42	16/10		9	8	8
	18/10		10		9
43	21/10		11	9	10
	23/10				11

37* 34 (cool) established cool regime

39* 35 (cool) transferred H south to H north to start cool temperature regime

FREEDOM

wk	date	rate	34(cool)	35(cool)	35(standard)
37*					
38	17/9	1.0ml l^{-1}	1	1	1
	20/9		2	2	2
39*	25/9		3	3	3
40	30/9		4	4	4
	2/10		5	5	5
41	7/10		6	6	6
	9/10		7	7	7
42	16/10		8	8	8
	18/10		9		9
43	21/10		10	9	10
	23/10				11

37* 34 (cool) established cool regime

39* 35 (cool) transferred H south to H north to start cool temperature regime

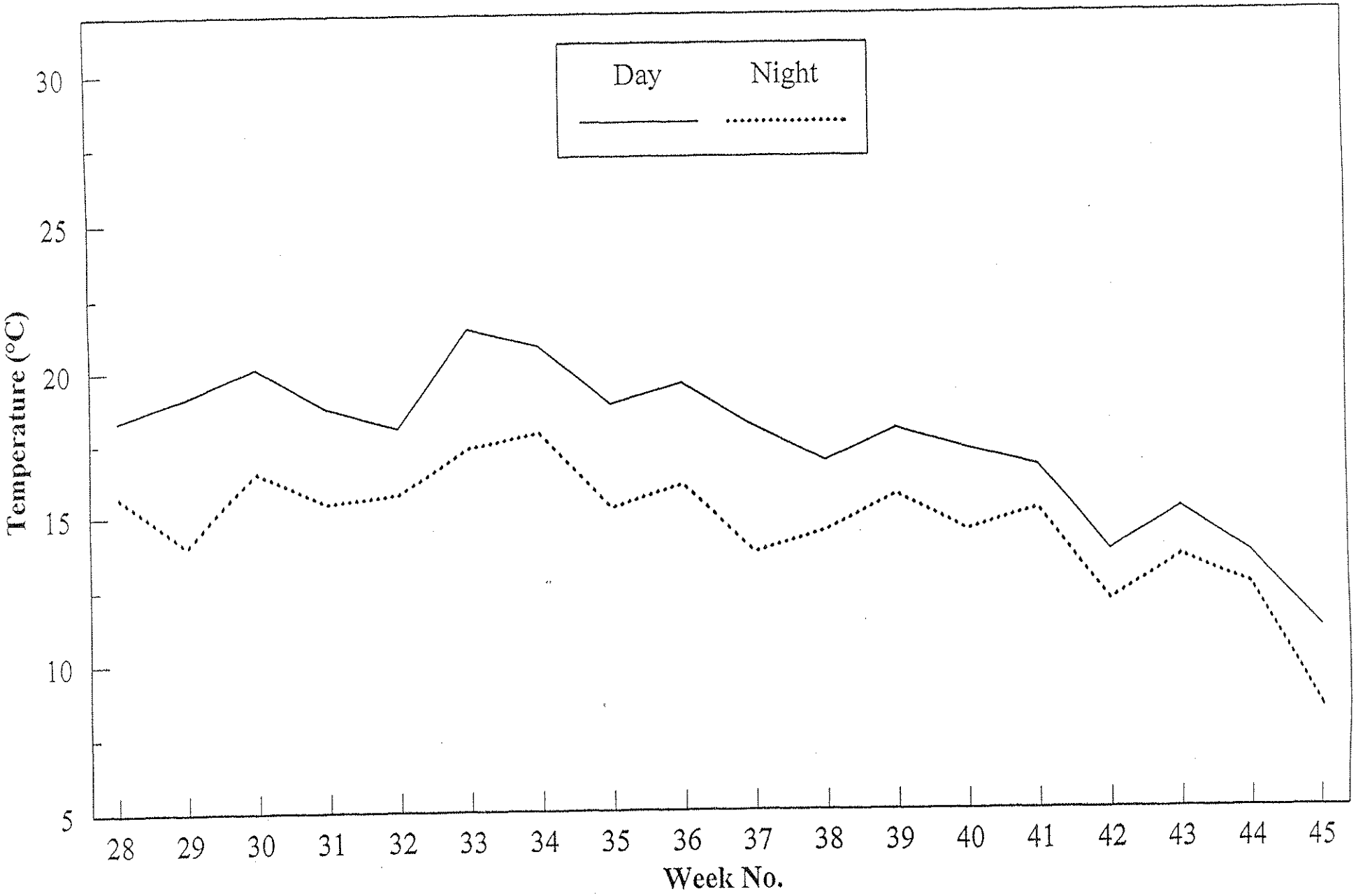
	wk	date	rate	34(cool)	35(cool)	35(standard)
RED SPLENDOUR						
	37*					
	38	17/9	1.0 ml l^{-1}	1	1	1
		20/9		2	2	2
	39*	25/9		3	3	3
	40	30/9		4	4	4
		2/10		5	5	5
	41	7/10		6	6	6
		9/10		7	7	7
	42	16/10		8	8	8
		18/10		9		9
	43	21/10		10	9	10
		23/10				11

37* 34 (cool) established cool regime

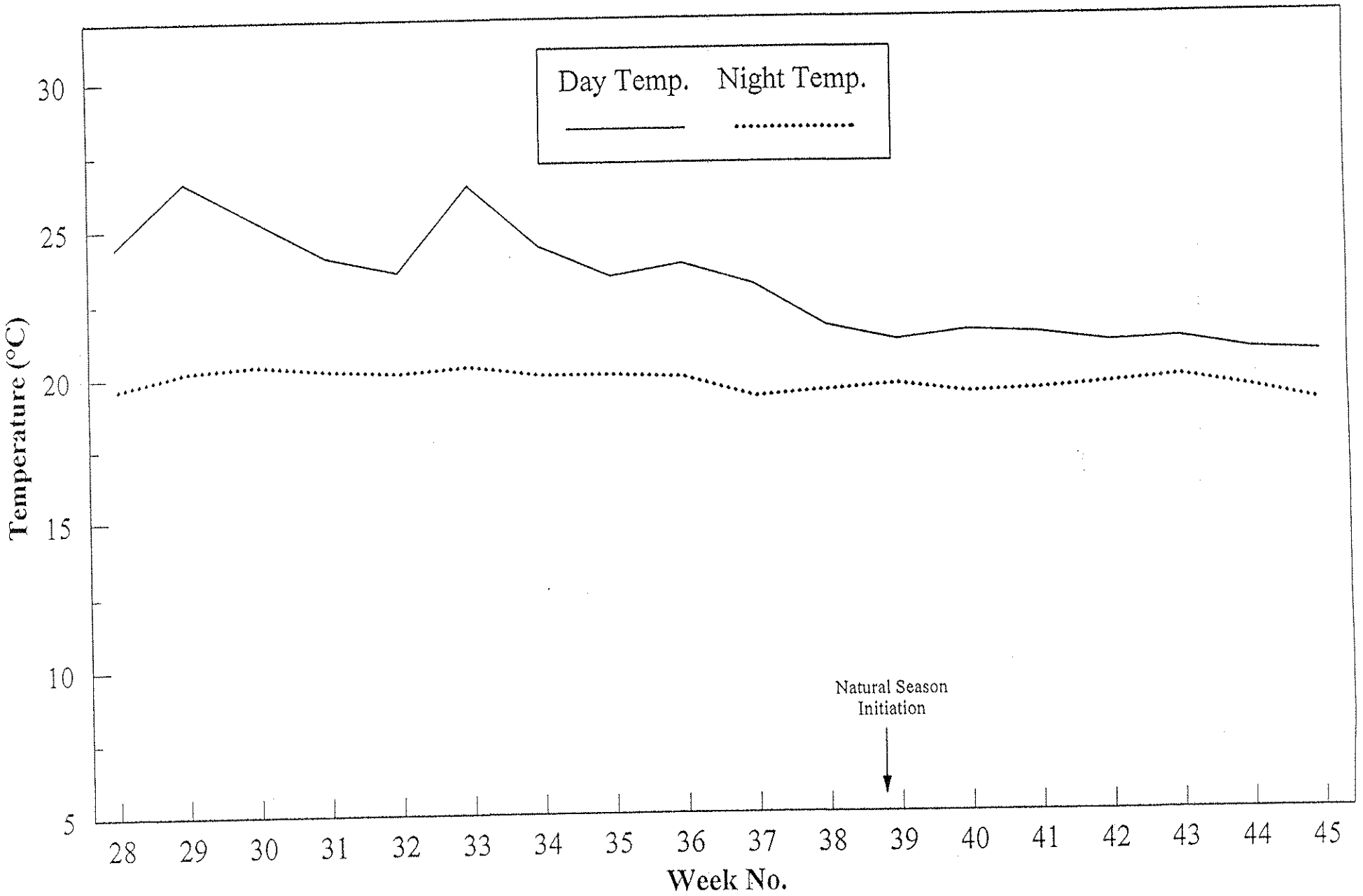
39* 35 (cool) transferred H south to H north to start cool temperature regime

APPENDIX III: ENVIRONMENTAL RECORDS

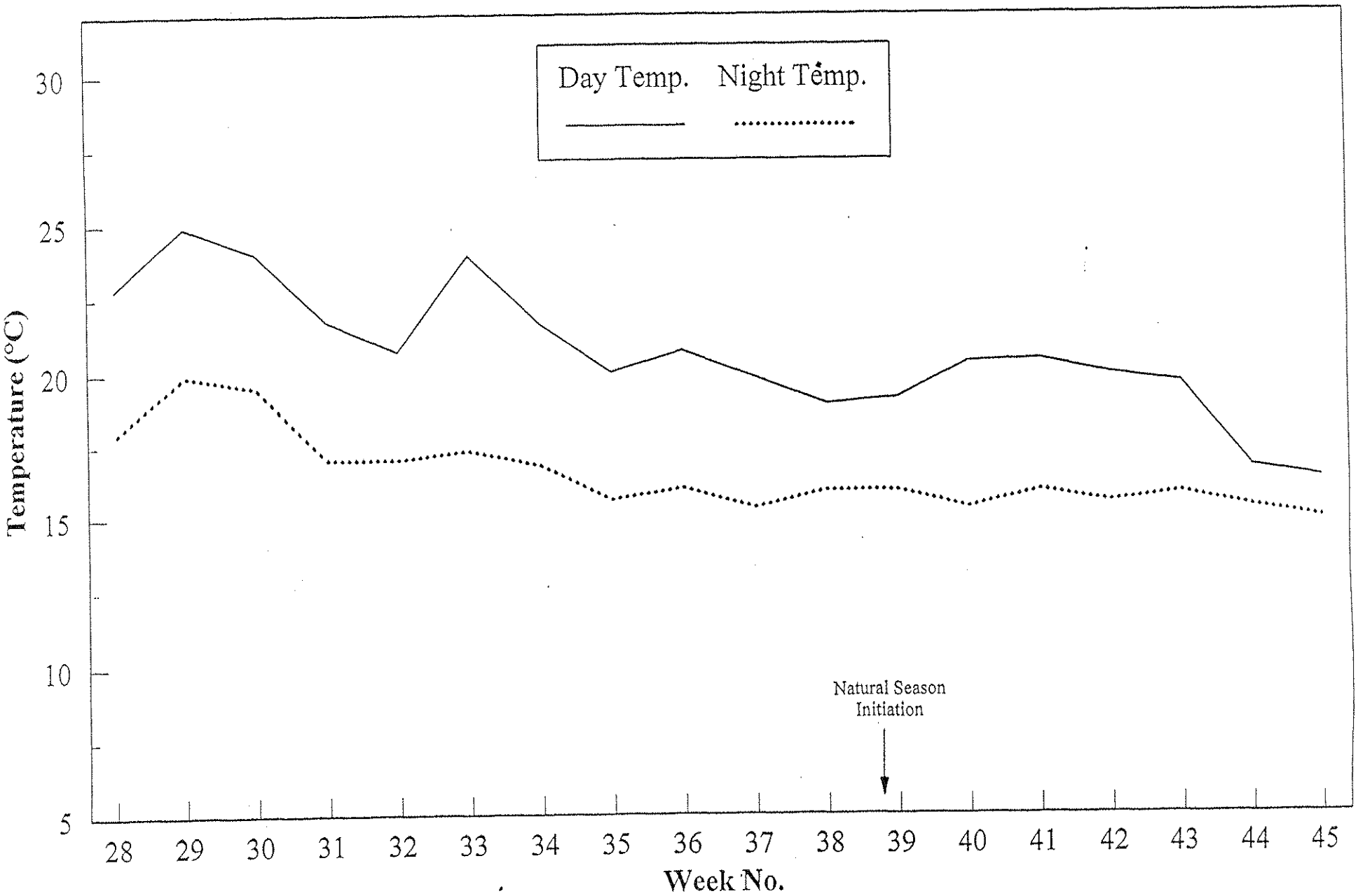
Outside Temperatures at HRI Efford 1996



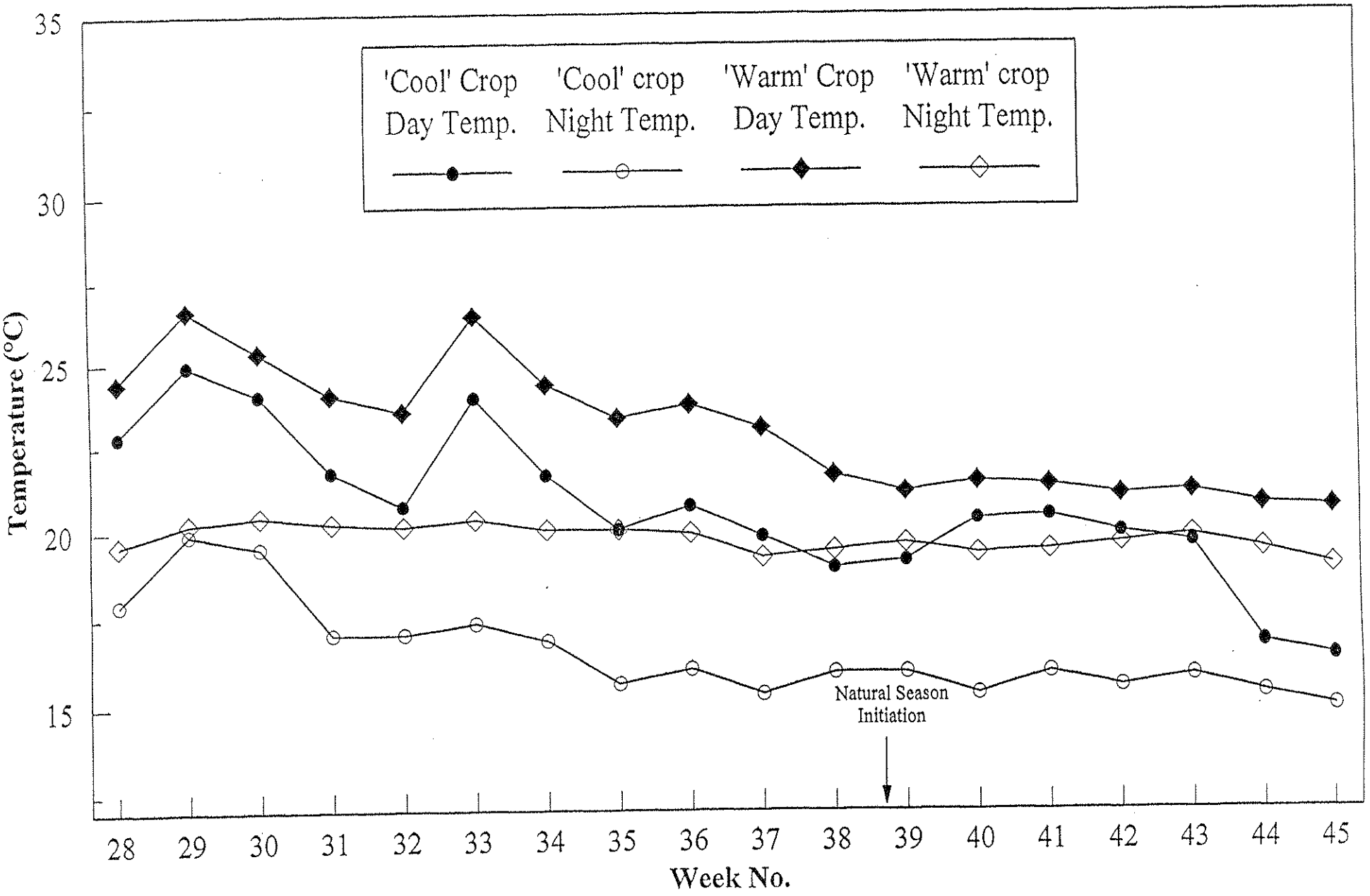
Glasshouse Temperature: 'Warm' grown crop



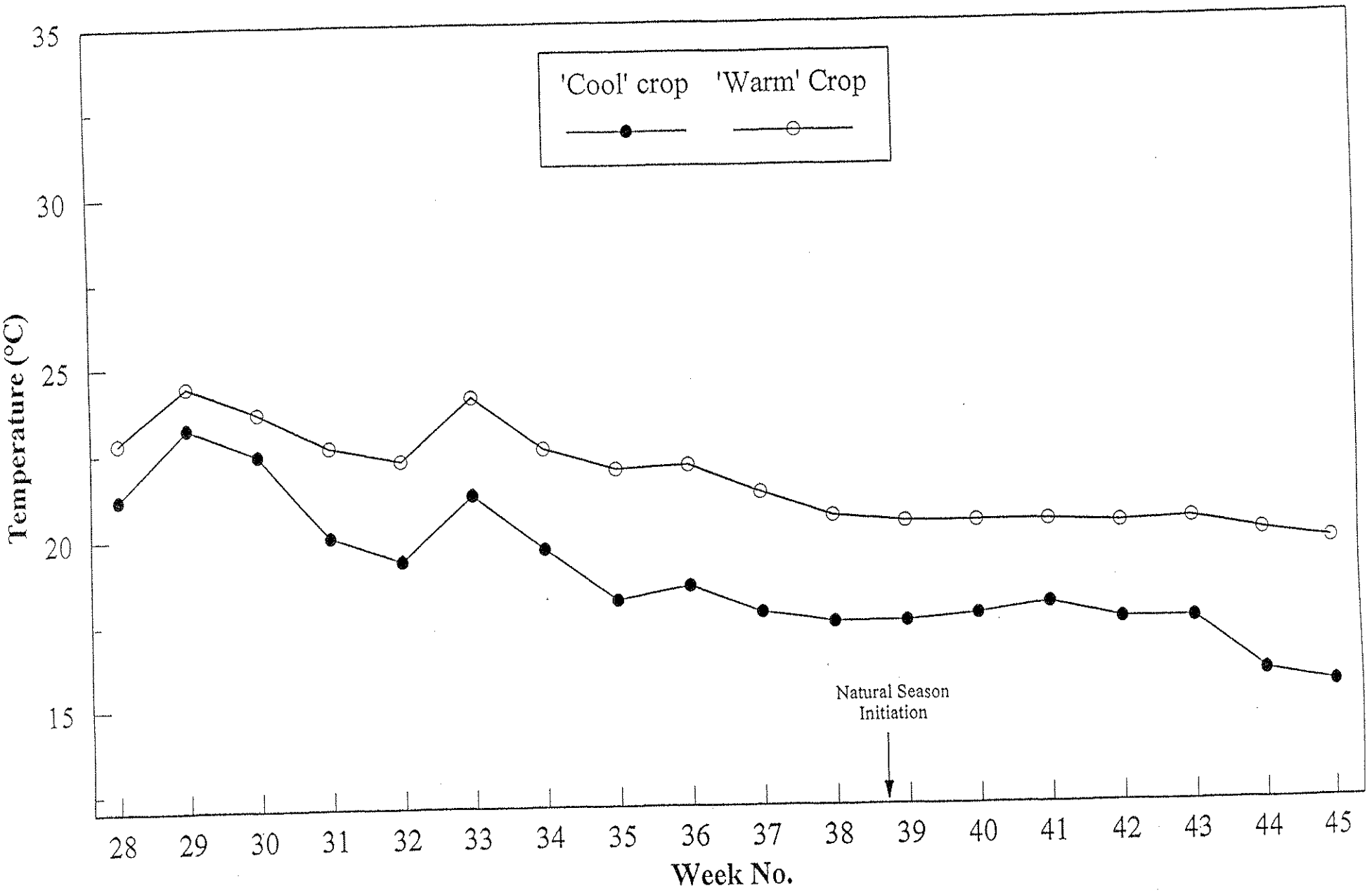
Glasshouse Temperature: 'Cool' grown crop



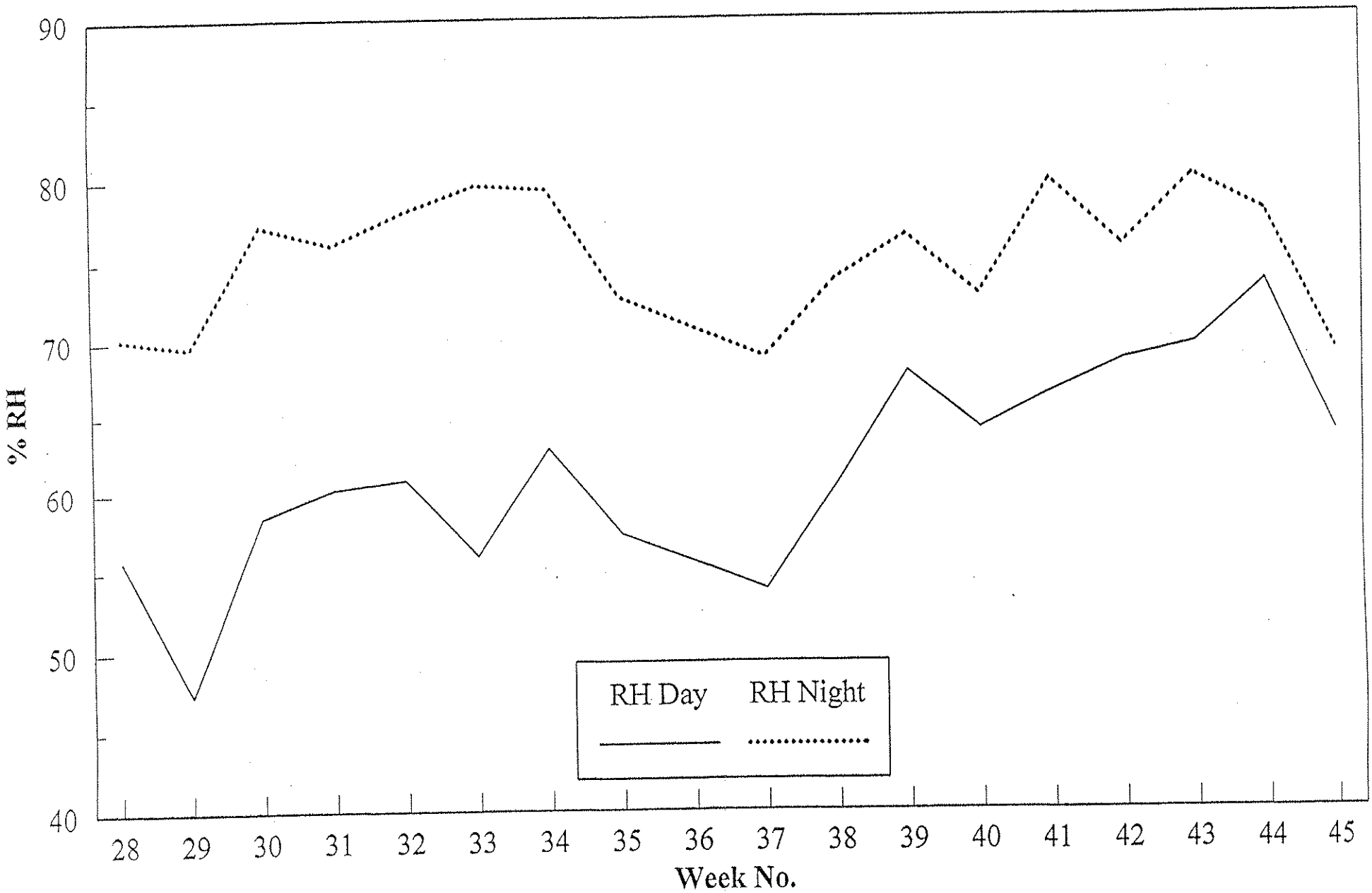
Glasshouse Temperature: 'Cool' vs 'Warm'



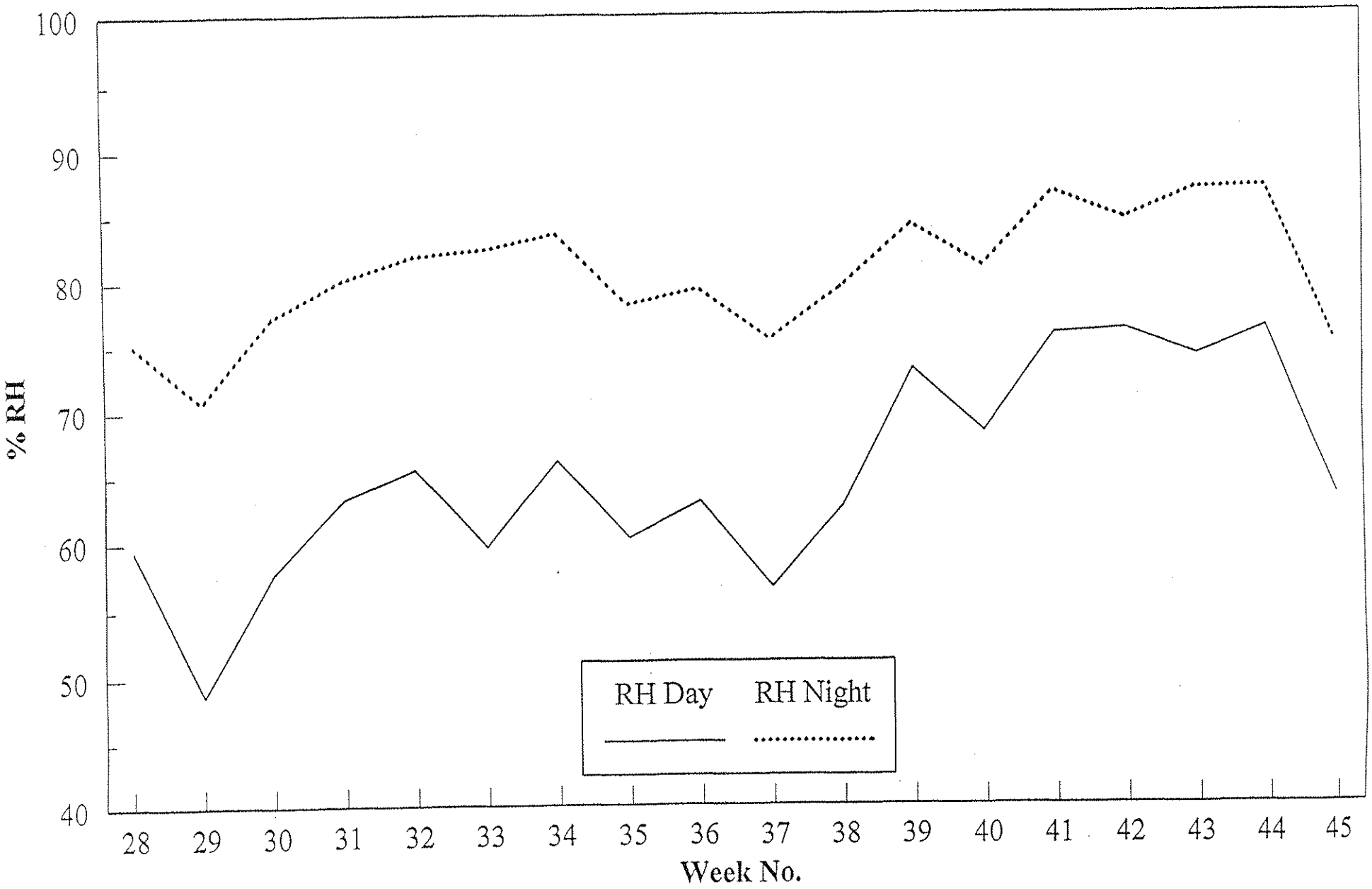
Glasshouse Average Temperature (24hrs): 'Cool' vs 'Warm'



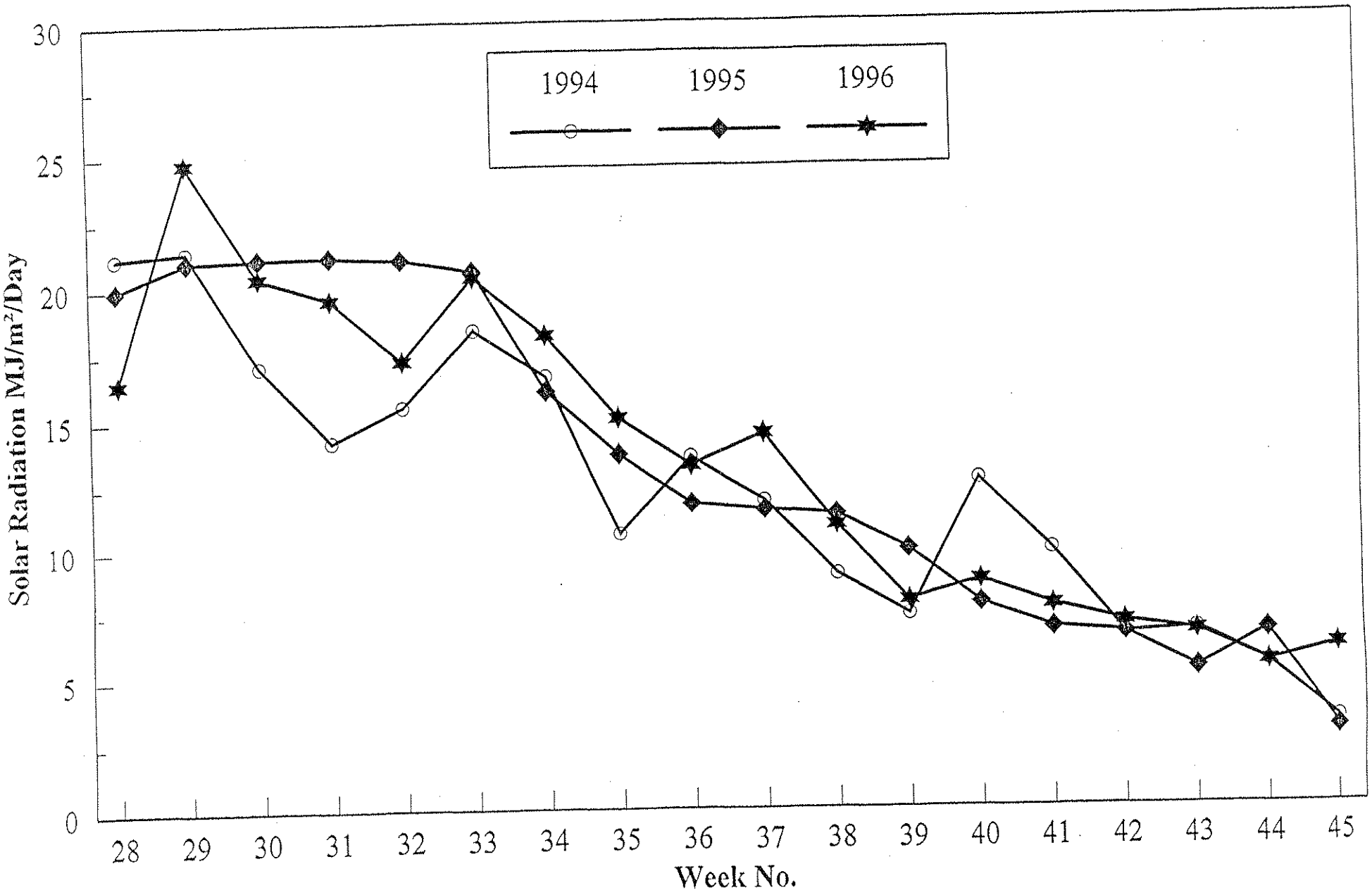
Glasshouse Relative Humidity: 'Warm' grown crop



Glasshouse Relative Humidity: 'Cool' grown crop

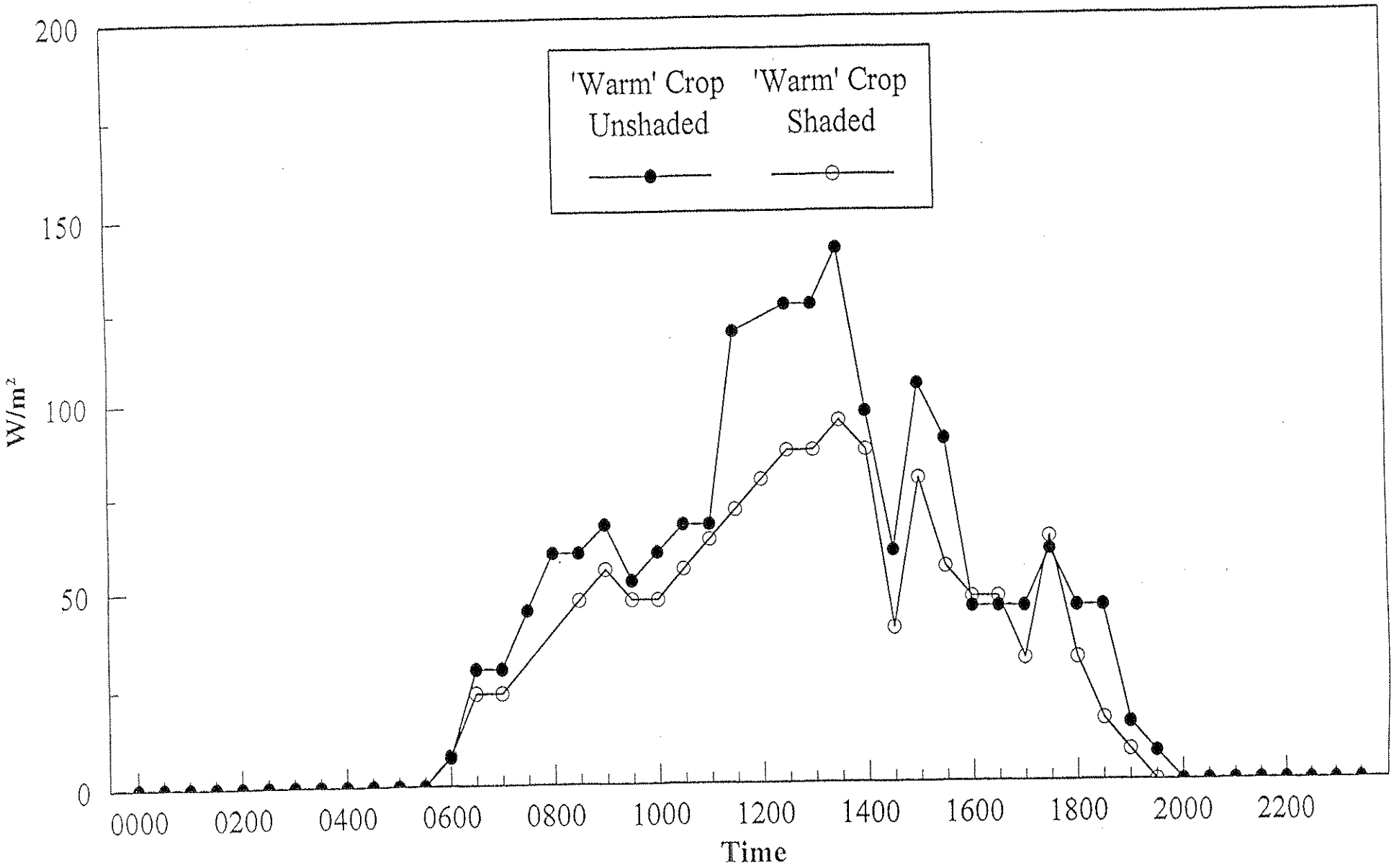


Outside Solar Radiation at HRI Efford 1996



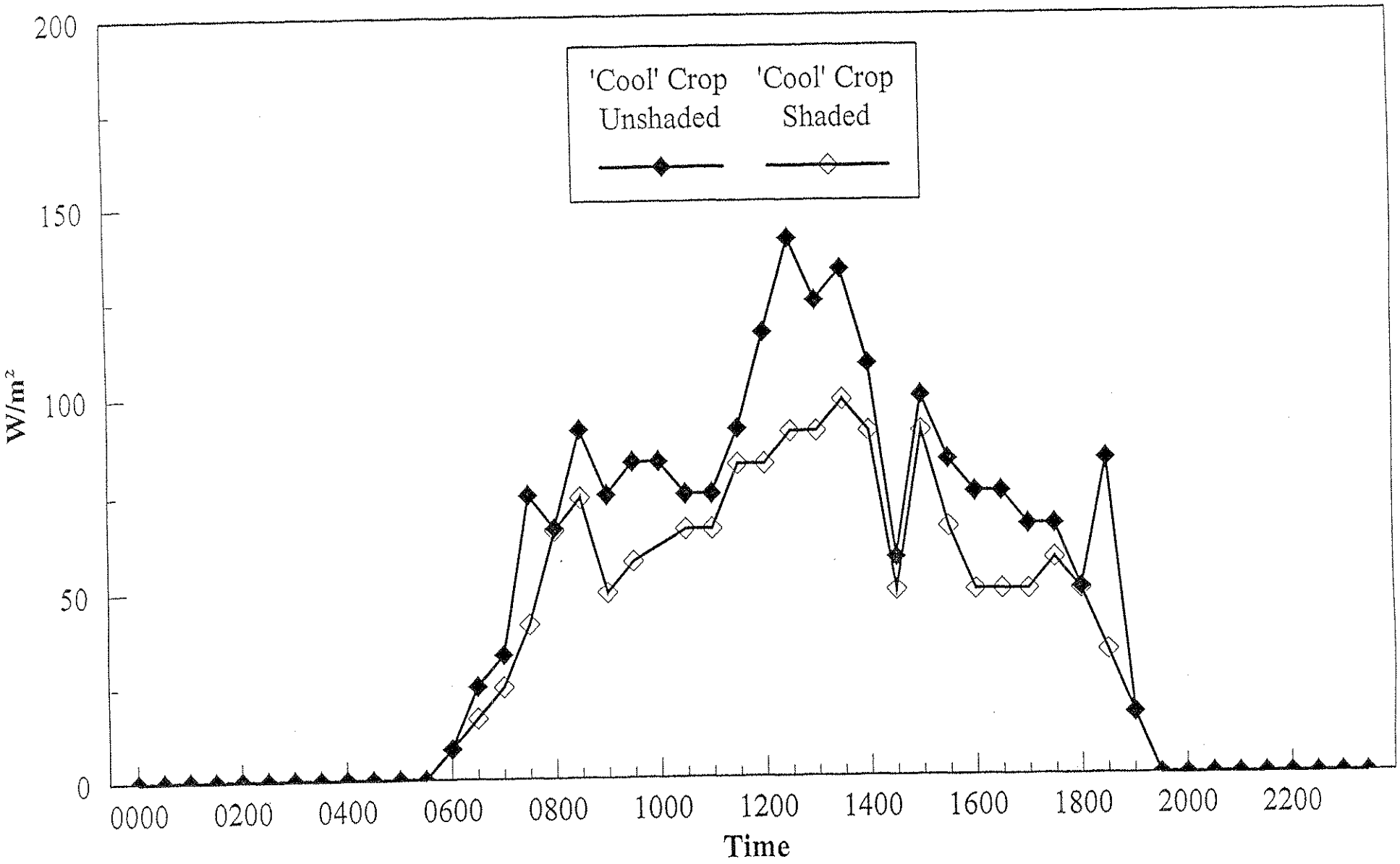
Instantaneous light levels (W/m^2)

Week 34 (21st. August)

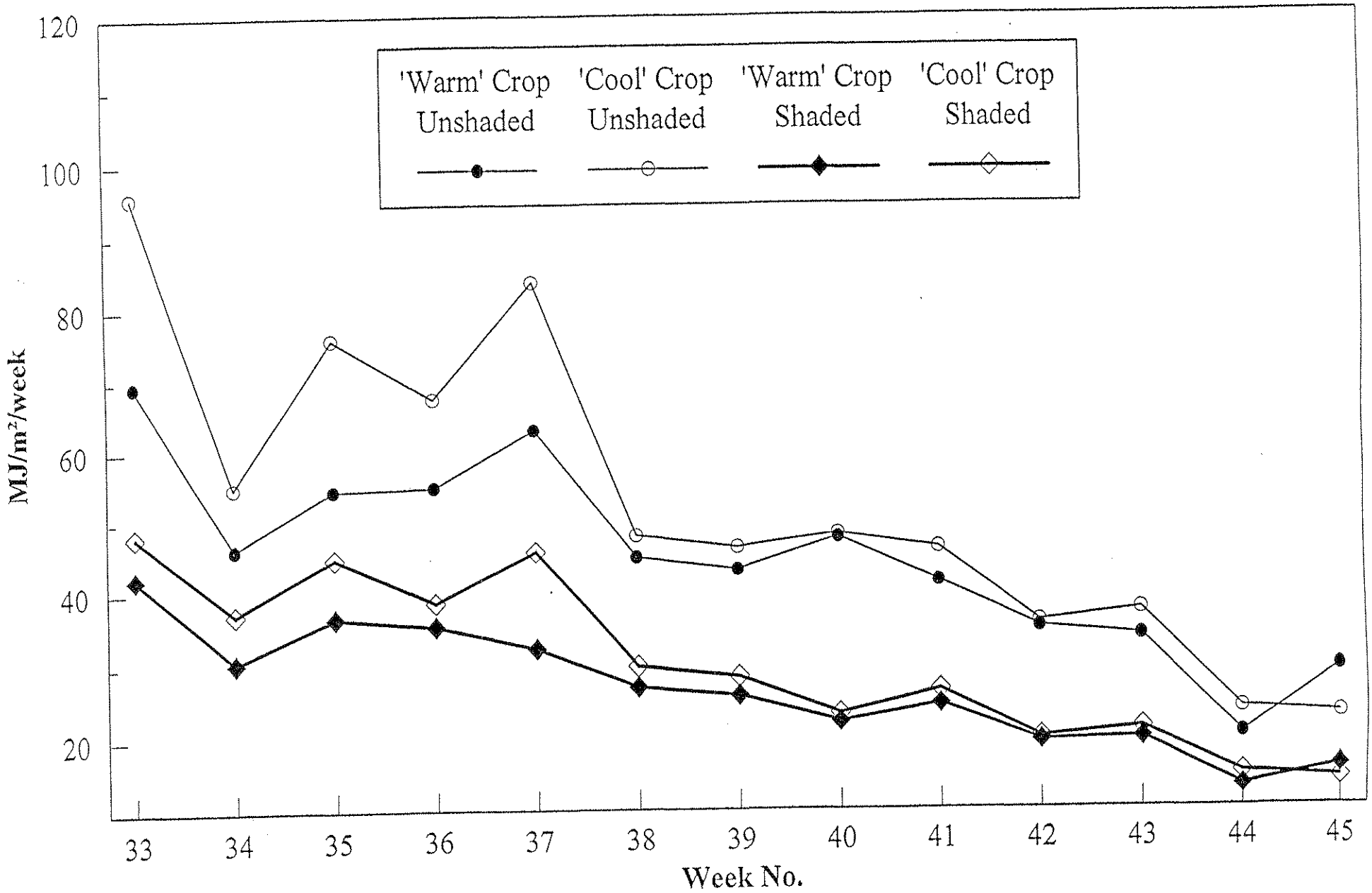


Instantaneous light levels (W/m^2)

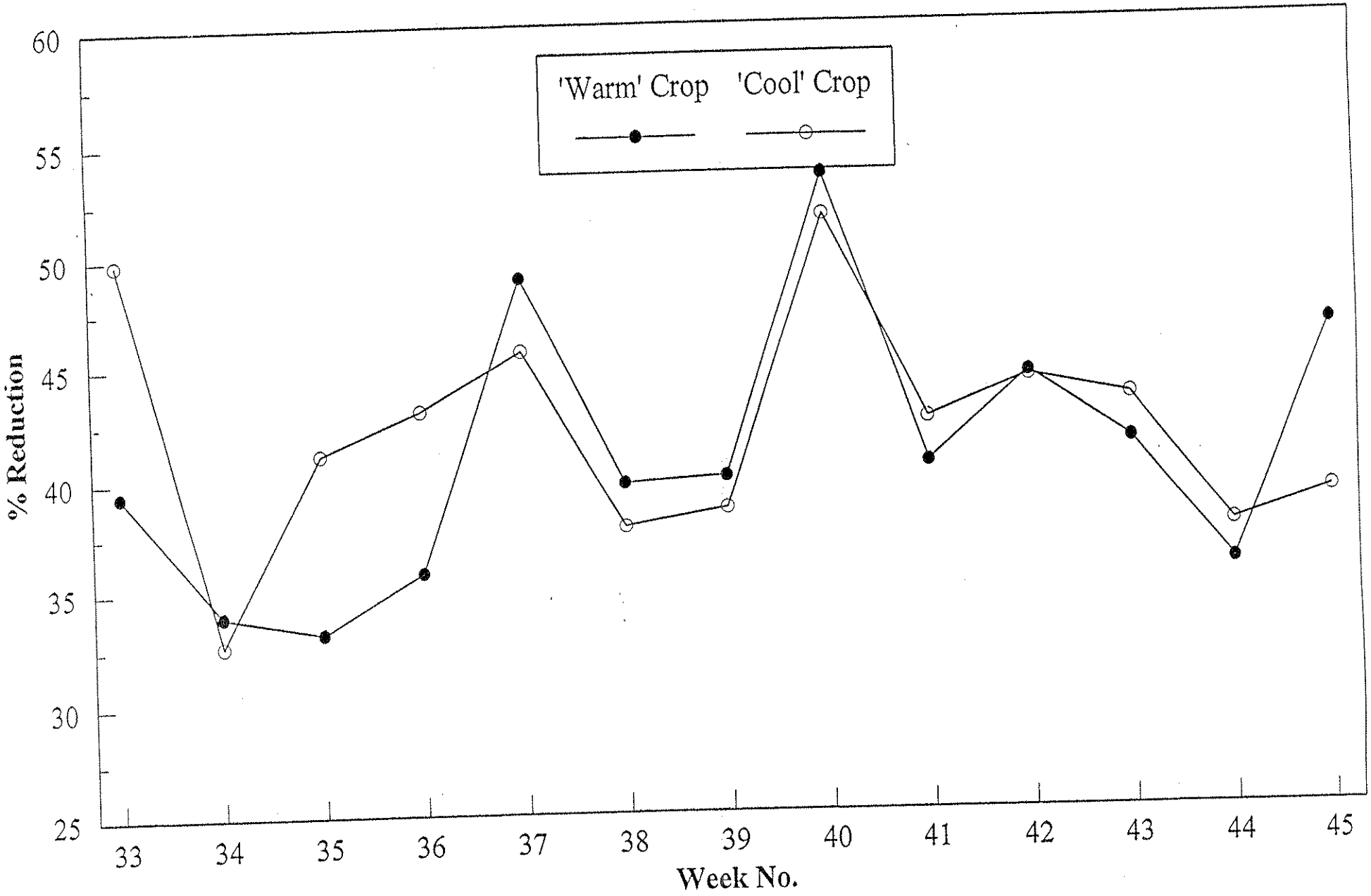
Week 34 (21st. August)



Total MJ/m²/week - 'Cool' vs 'Warm'



% Reduction in Solar Radiation under shade - 'Cool' vs 'Warm'



APPENDIX IV: MAIN TRIAL - GROWING MEDIA ANALYSES

Schedule of Poinsettia Media Analyses

Week 28 (cool)		Week 30 (cool)		Week 31 (warm)	
Potting	12 July	Potting	24 July	Potting	31 July
4 wks	9 Aug	2 wks	9 Aug		
6 wks	22 Aug	4 wks	22 Aug	3 wks	22 Aug
8 wks	9 Sep	6 wks	9 Sep	5 wks	9 Sep
10 wks	23 Sep	8 wks	23 Sep	7 wks	23 Sep
12 wks	7 Oct	10 wks	7 Oct	9 wks	7 Oct
14 wks	21 Oct	12 wks	21 Oct	11 wks	21 Oct
16 wks	31 Oct	14 wks	31 Oct	13 wks	31 Oct
18 wks	15 Nov	16 wks	15 Nov	15 wks	15 Nov

APPENDIX IV

Growing Media Analysis* for week 28 potting (plants grown cool)

	At potting	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks	14 weeks	16 weeks	18 weeks
pH			5.6	5.4	5.3	5.7	5.7	5.9	6.7	6.7
Conductivity (EC)μScm^{-1}			403	423	379	210	331	406	147	160
Ammonium-Nitrogen (H- (NH_4-N)				14	68	29	8	2	1	11
Nitrate-Nitrogen (NO_3 -N)			42	187	168	80	77	51	25	37
Phosphorus (P)			7	63	33	17	35	17	9	15
Pottasium (K)			77	190	130	66	62	57	44	79
Magnesium (Mg)			6	73	50	32	45	19	7	9
Calcium (Ca)			18	216	152	88	156	52	29	31
Sodium (Na)			79	71	47	53	58	47	60	63
Chloride (Cl)			115	69	84	99	96	60	83	76
Sulphate(SO_4)			56	284	227	124	342	98	73	74
Copper (Cu)			0.10	0.10	0.08	0.06	0.06	0.41	0.74	1.50
Manganese (Mn)			0.06	0.30	0.24	0.15	0.09	0.36	0.37	0.71
Zinc (Zn)			0.19	0.30	0.24	0.29	0.35	0.13	0.18	1.32
Iron (Fe)			1.53	2.20	1.22	0.96	0.53	4.02	2.22	4.32
Boron (B)			0.86	0.06	0.24	0.52	0.27	0.52	0.52	0.79

*Water available - extractable analysis

APPENDIX IV

Growing Media Analysis* for week 30 potting (plants grown cool)

	At Potting	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks	14 weeks	16 weeks
pH	5.5	5.6	5.5	5.2	5.3	5.4	5.6	5.8	6.1
Conductivity (EC)µScm-1	426	344	423	411	387	289	193	237	321
Ammonium Nitrogen (Nn_4-N)	29	12	121	66	59	12	1	1	1
Nitrate-Nitrogen (NO_3 -N)	36	39	173	203	151	106	71	95	116
Phosphorus (P)	18	9	71	43	65	31	23	29	45
Pottasium (K)	82	127	200	159	136	71	80	116	153
Magnesium (Mg)	11	18	51	54	66	44	29	33	49
Calcium (Ca)	23	36	102	122	140	120	60	88	121
Sodium (Na)	59	129	64	17	47	48	43	50	61
Chloride (Cl)	92	164	63	76	76	77	54	52	66
Sulphate (SO_4)	81	147	282	188	328	201	115	145	201
Copper (Cu)	0.07	0.08	0.06	0.09	0.06	0.06	0.20	0.48	1.36
Manganese (Mn)	0.07	0.08	0.33	0.28	0.23	0.09	0.13	0.19	0.77
Zinc (Zn)	0.14	0.42	0.22	0.19	0.23	0.18	0.60	0.87	1.19
Iron (Fe)	1.43	1.78	1.89	1.40	1.29	0.27	4.55	7.07	9.03
Boron (B)	0.75	0.85	0.06	0.37	0.61	0.62	0.47	0.58	0.85

*Water available - extractable analysis

APPENDIX IV

Growing Media Analysis * for week 31 potting (plants grown warm)

	At Potting	3 weeks	5 weeks	7 weeks	9 weeks	11 weeks	13 weeks	15 weeks
pH	5.5	5.6	5.5	5.4	5.4	5.8	6.4	6.2
Conductivity (EC)μScm-1	426	390	566	264	260	169	150	242
Ammonium Nitrogen(Nn_4-N)	29	103	101	28	3	1	1	1
Nitrate - Nitrogen(NO_3-N)	36	150	237	123	102	34	36	85
Phosphorus (P)	18	61	85	30	29	23	19	27
Pottasium (K)	82	184	160	96	79	51	54	136
Magnesium (Mg)	11	49	88	43	44	25	15	27
Calcium (Ca)	23	103	183	96	101	68	40	62
Sodium (Na)	59	64	68	42	43	44	51	72
Chloride (Cl)	92	71	101	78	61	53	50	72
Sulphate (SO_4)	81	274	425	133	139	206	105	104
Copper (Cu)	0.07	0.10	0.08	0.06	0.06	0.06	0.54	1.36
Manganese (Mn)	0.07	0.31	0.42	0.16	0.16	0.06	0.39	0.58
Zinc (Zn)	0.14	0.20	0.34	0.16	0.08	0.38	0.85	1.26
Iron (Fe)	1.43	2.04	1.68	0.88	0.47	1.96	5.03	9.01
Boron (B)	0.75	0.06	0.25	0.64	0.47	0.32	0.46	0.68

*Water available - extractable analysis

APPENDIX V: Main Trial - Colour Plates

Plate 2: **Comparison of Main Trial Treatments for Freedom - Shaded (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).**

APPENDIX V: Main Trial - Colour Plates

Plate 3: Comparison of Main Trial Treatments for Ria - no Shade (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).

APPENDIX V: Main Trial - Colour Plates

Plate 4: Comparison of Main Trial Treatments for Ria - Shaded (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).

APPENDIX V: Main Trial - Colour Plates

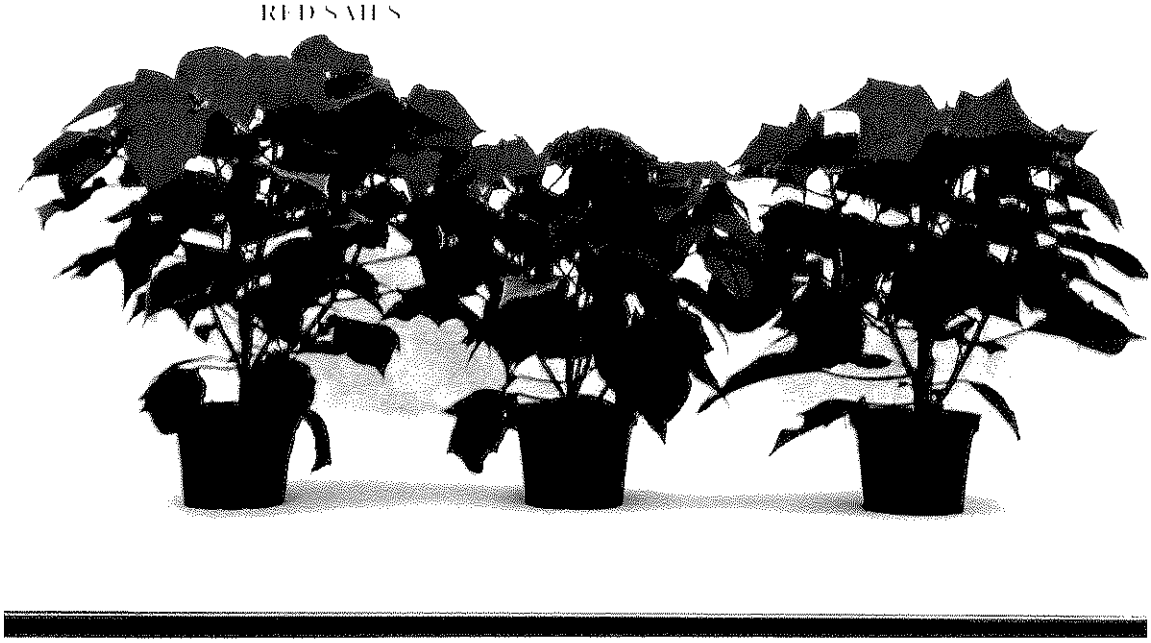
Plate 5: **Comparison of Main Trial Treatments for Sonora - no Shade (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).**

APPENDIX V: Main Trial - Colour Plates

Plate 6: **Comparison of Main Trial Treatments for Sonora - Shaded (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).**

APPENDIX V: Main Trial - Colour Plates

Plate 7: **Comparison of Main Trial Treatments for Red Sails - no Shade (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).**



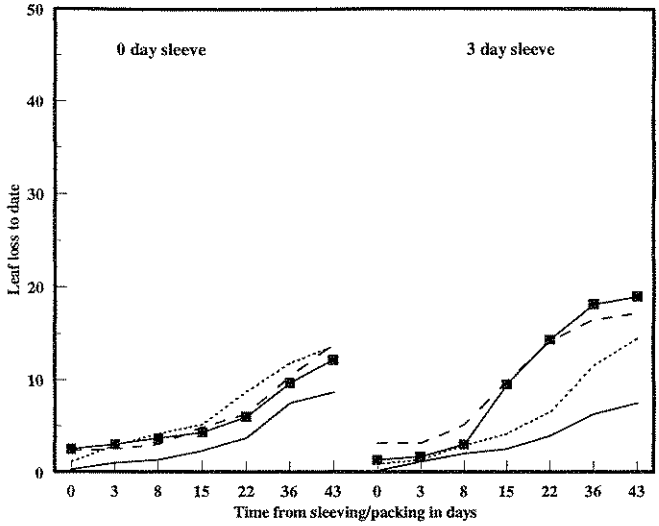
APPENDIX V: MAIN TRIAL - COLOUR PLATES

Plate 1: **Comparison of Main Trial Treatments for Freedom - no Shade (top, 10 plants/m^2; bottom 12 plants/m^2; left, week 31 warm; middle, week 30 cool; right, week 28 cool).**

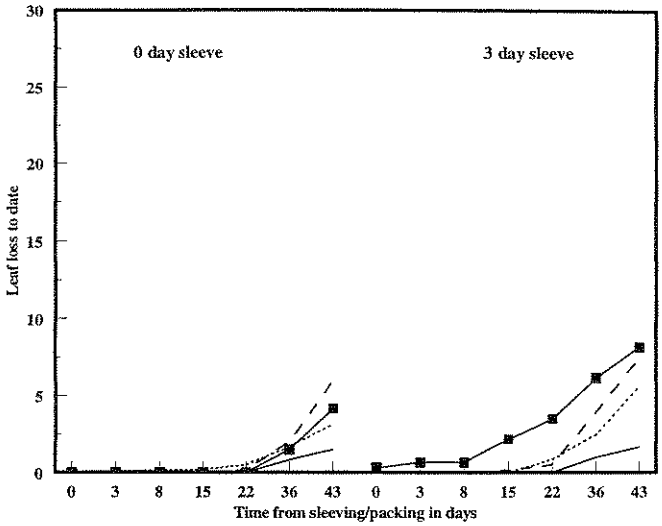
APPENDIX VI: MAIN TRIAL - SHELF-LIFE RESULTS

Variety: Freedom

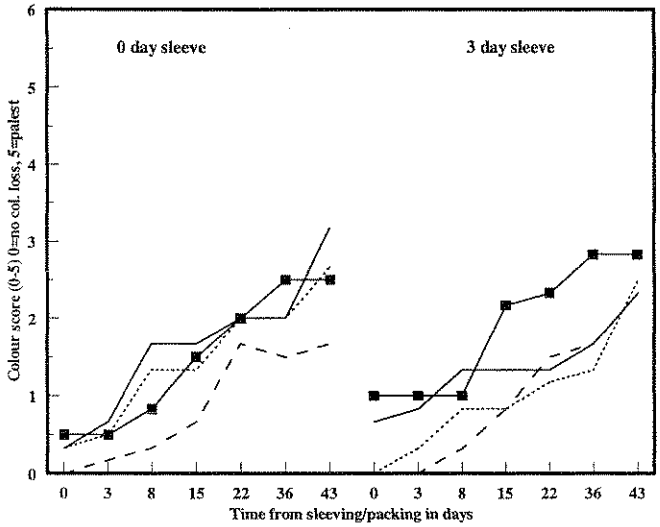
Green leaf loss



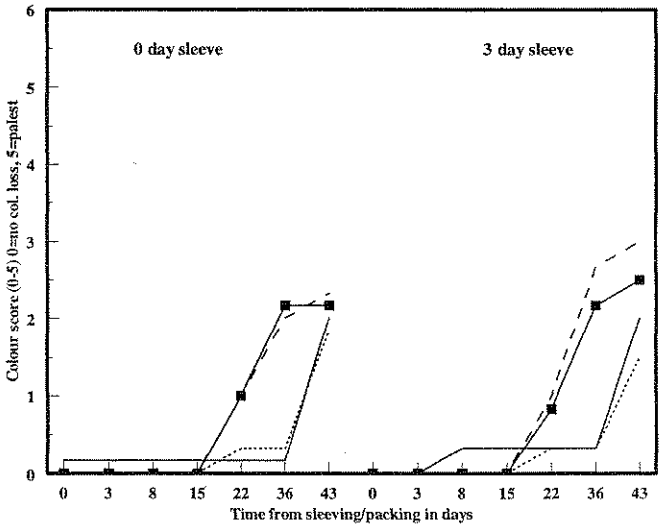
Red bract leaf loss



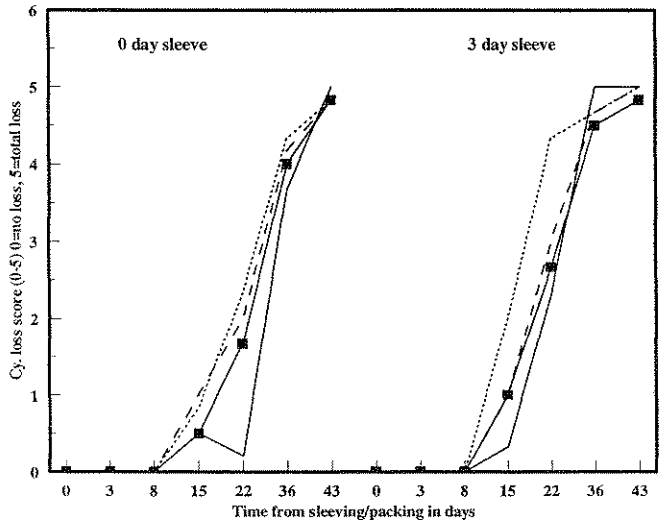
Green leaf colour



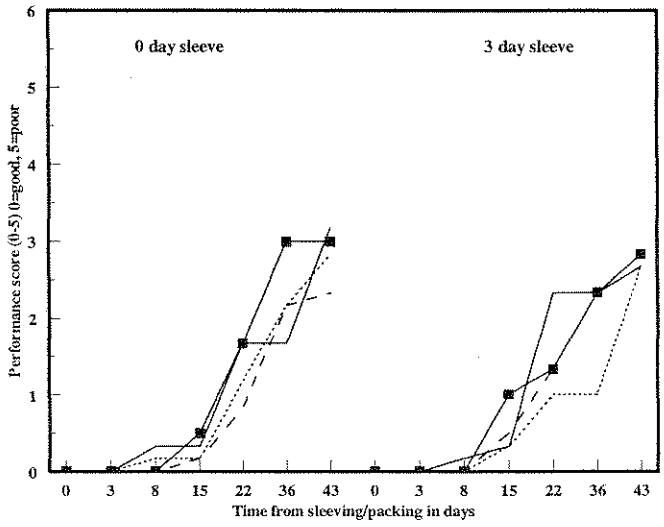
Bract colour



Cyathia loss

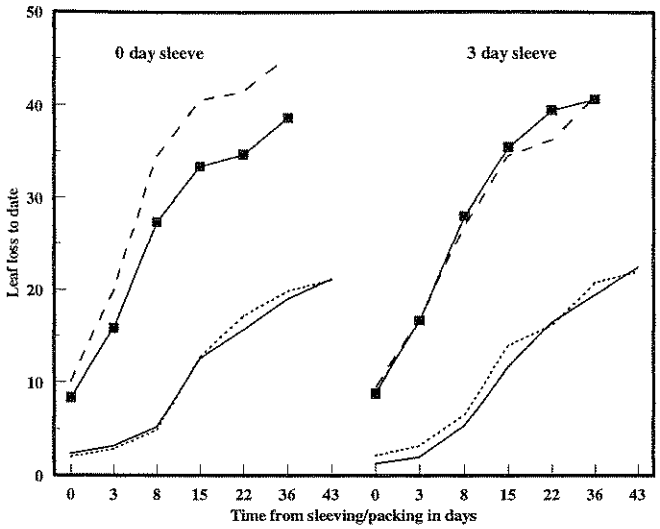


Overall Performance

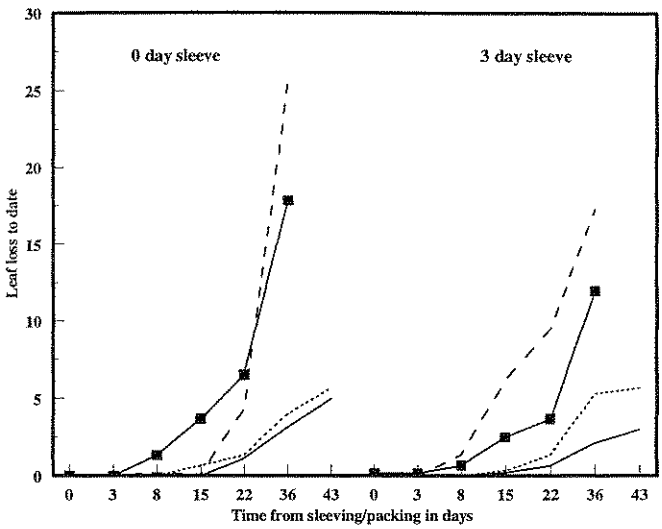


Variety: Sonora

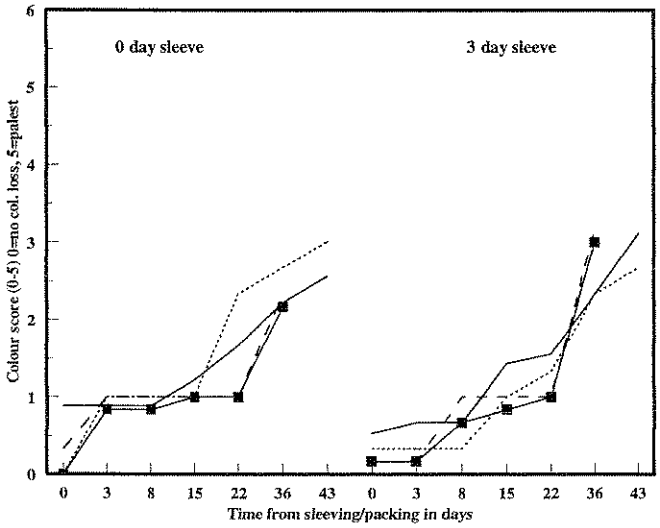
Green leaf loss



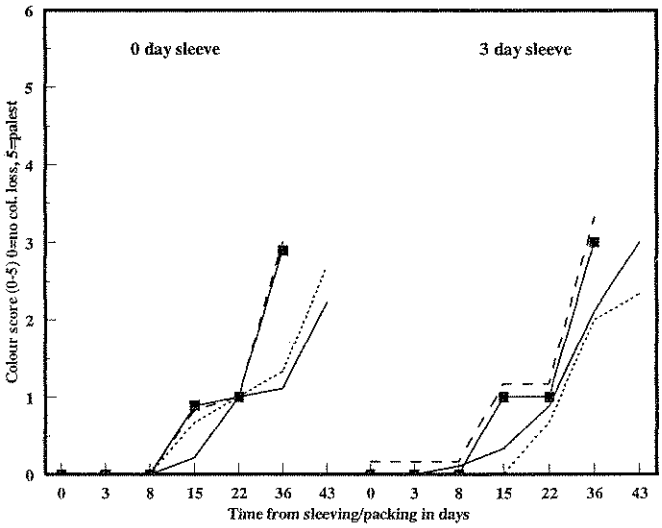
Red bract leaf loss



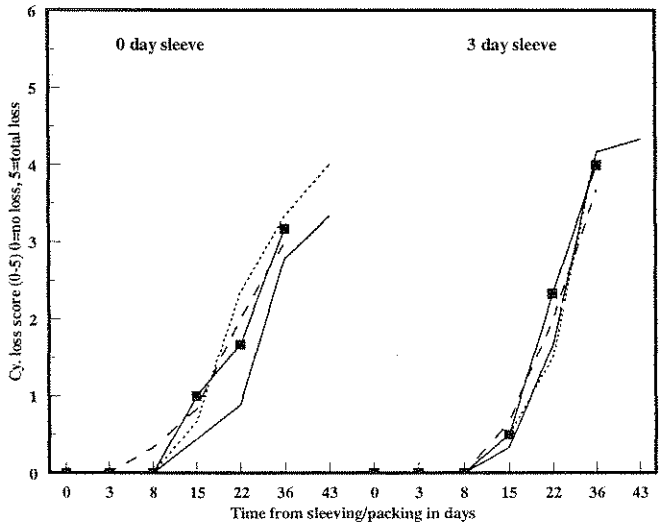
Green leaf colour



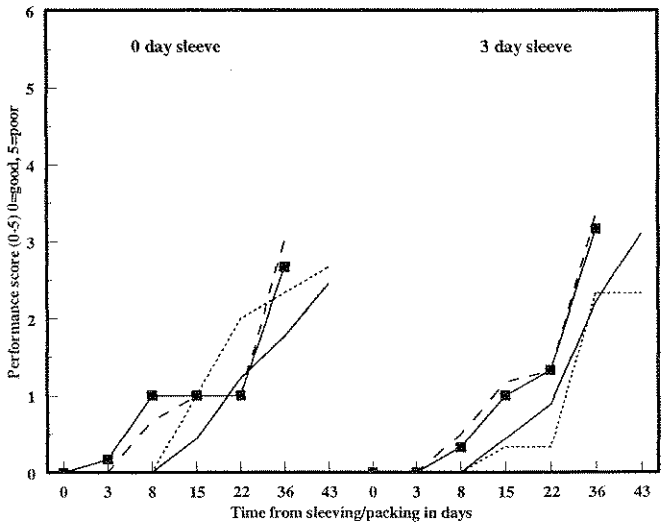
Bract colour



Cyathia loss

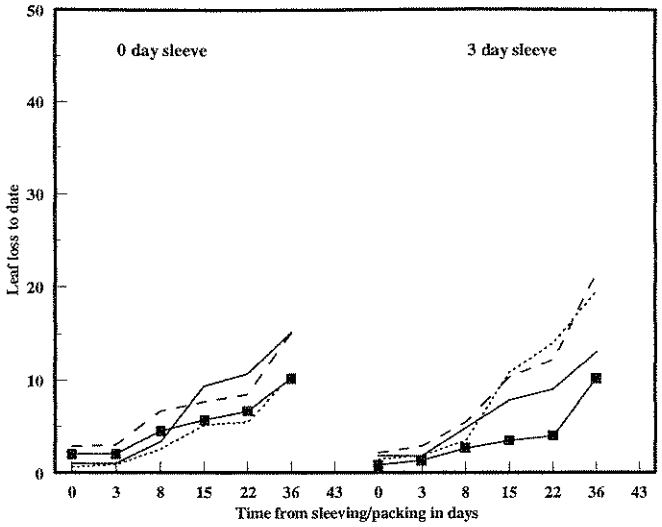


Overall Performance

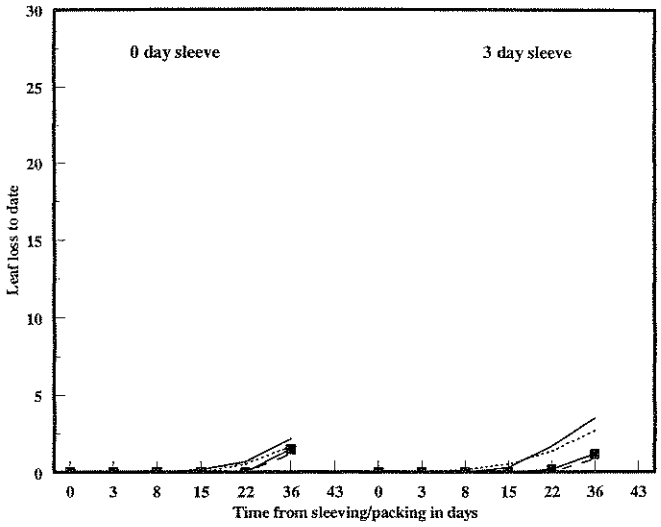


Variety: Ria

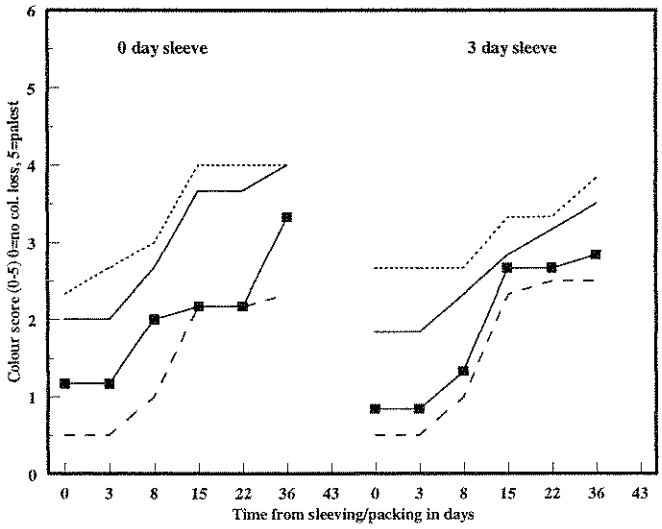
Green leaf loss



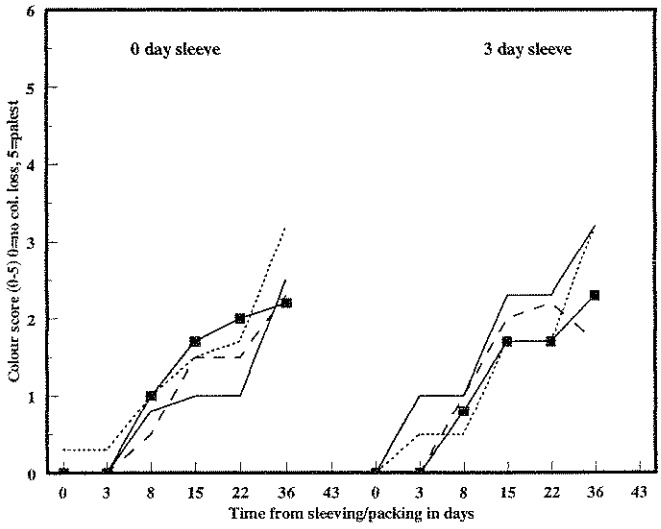
Red bract leaf loss



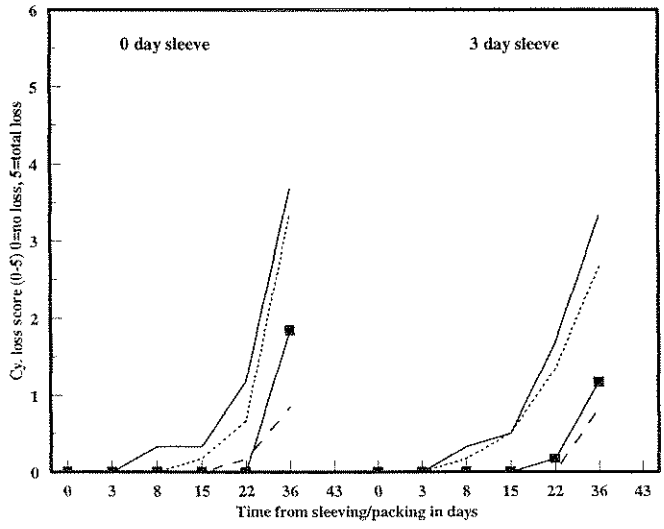
Green leaf colour



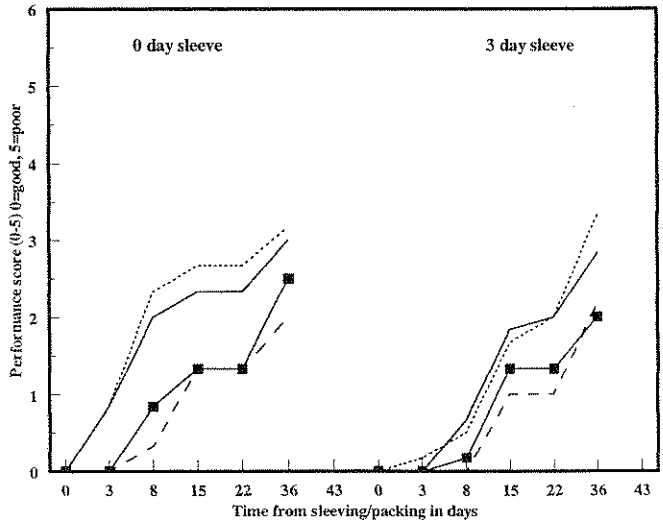
Bract colour



Cyathia loss

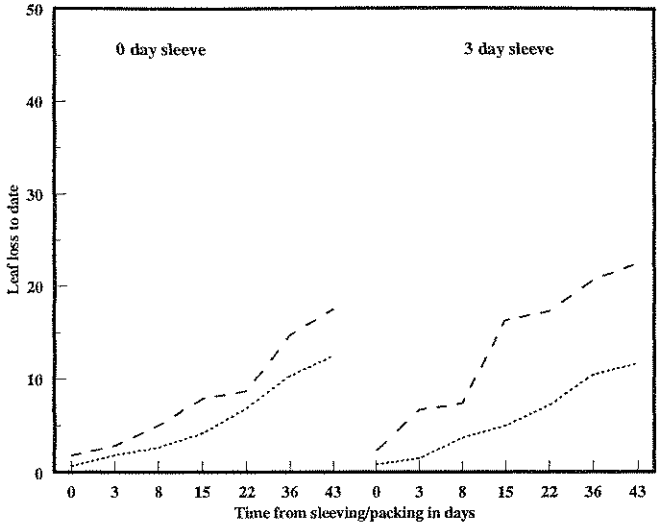


Overall Performance

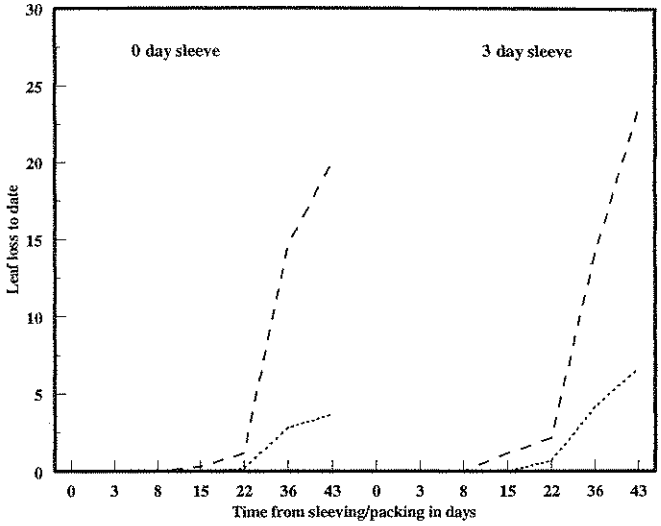


Variety: Red Sails

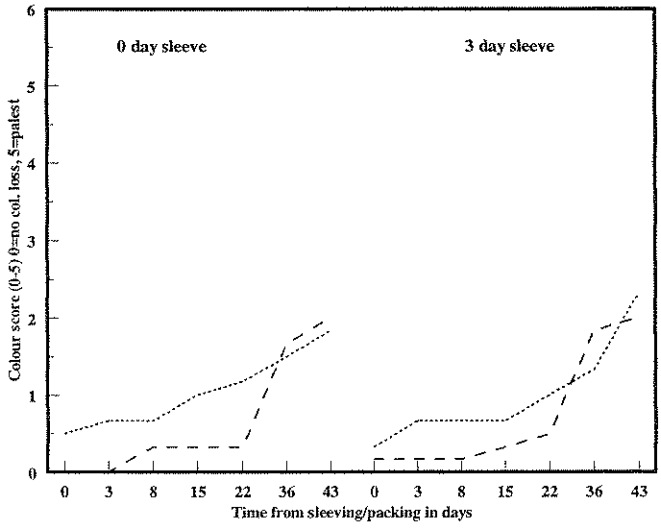
Green leaf loss



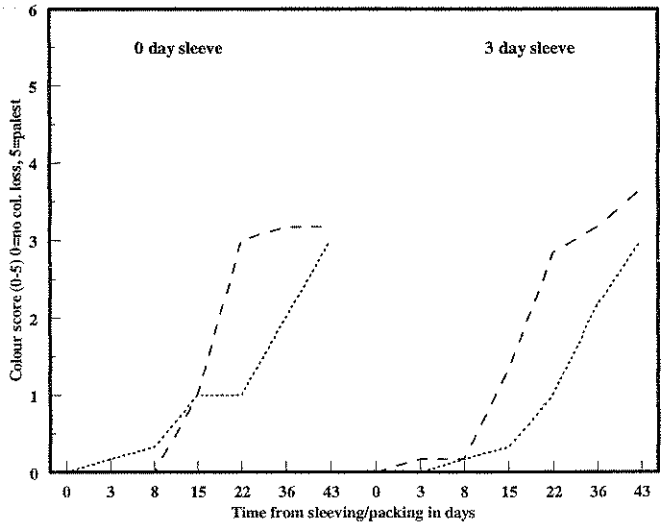
Red bract leaf loss



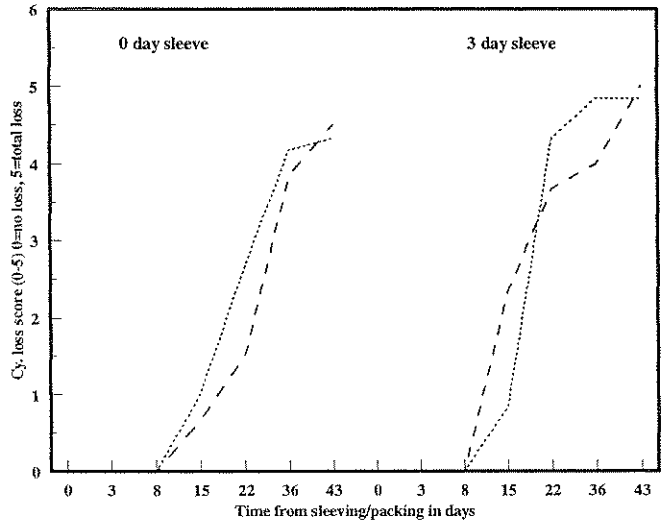
Green leaf colour



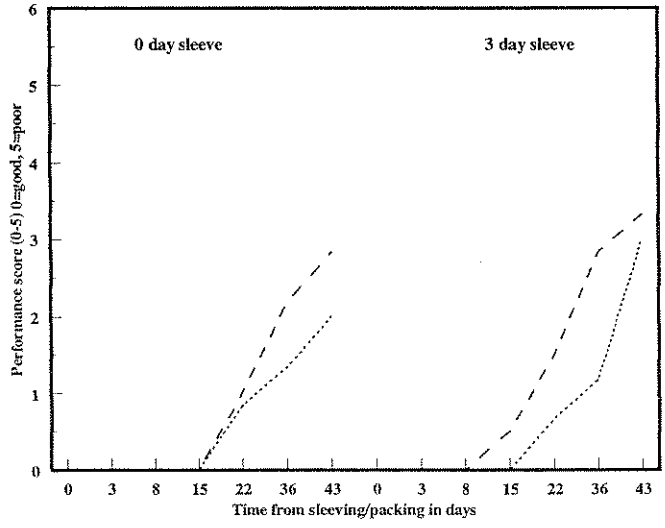
Bract colour



Cyathia loss



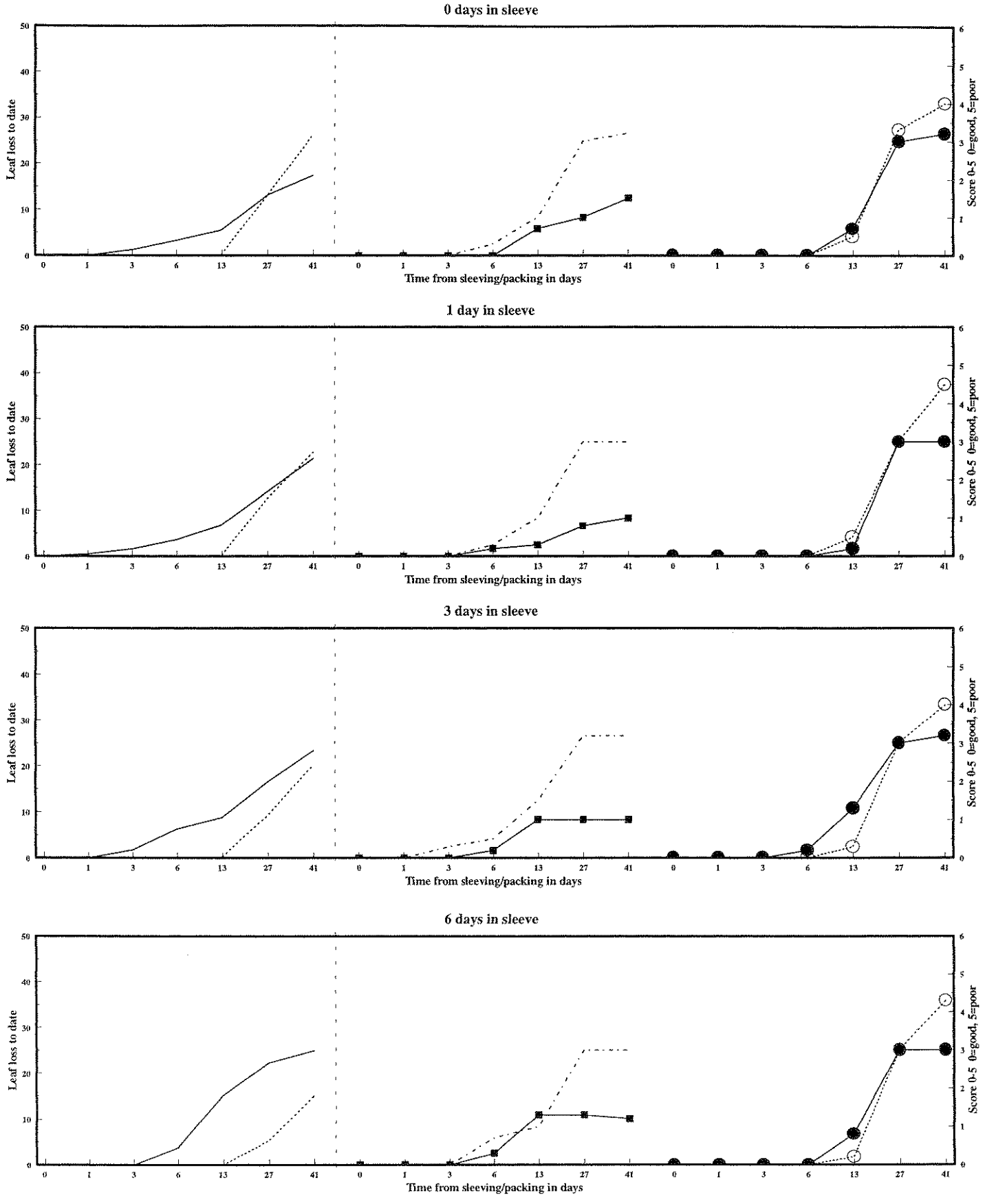
Overall Performance



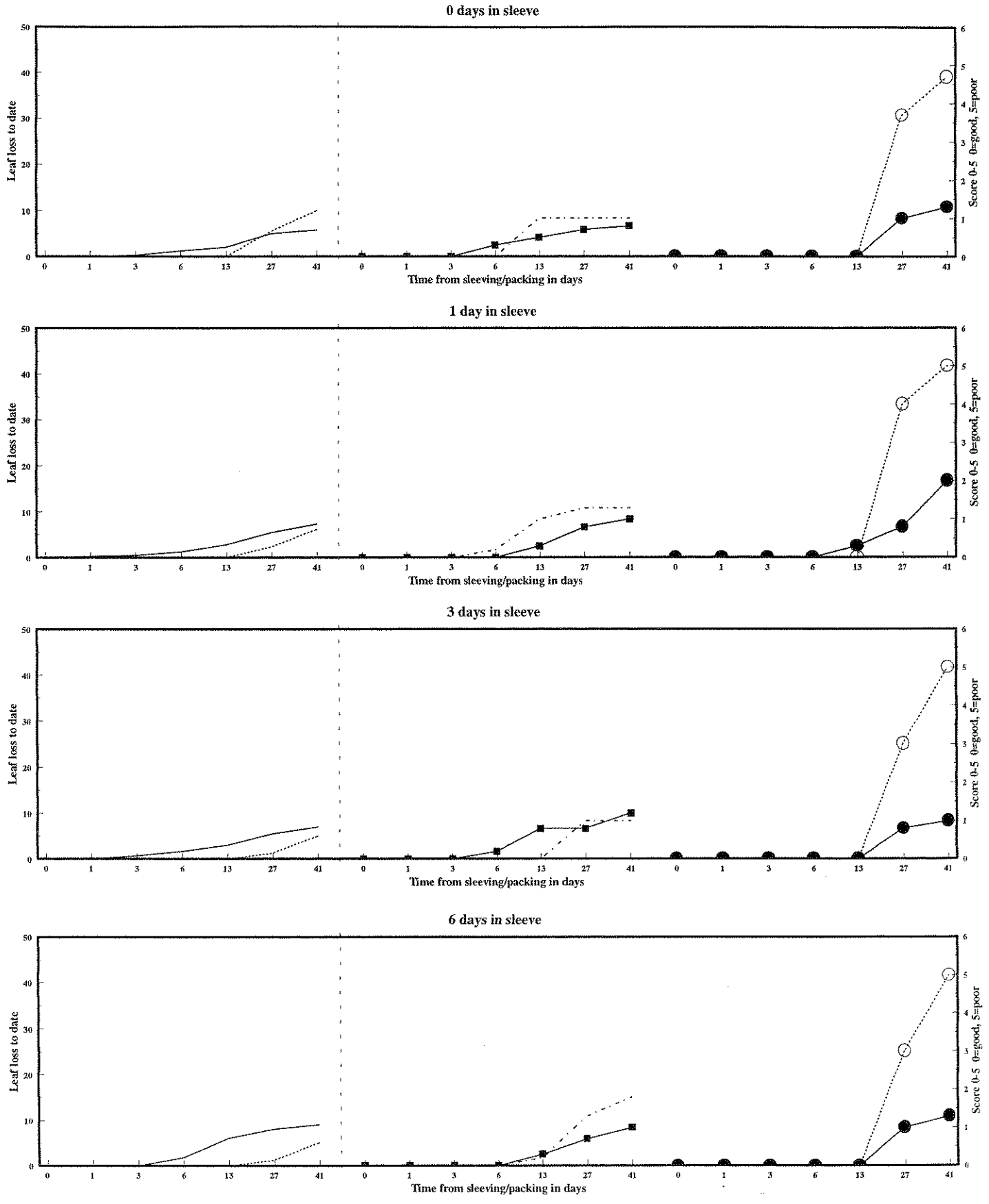
Note: Red Sails were unshaded only

APPENDIX VII: COMMERCIAL RED SAILS PLANTS - SHELF-LIFE RESULTS

Variety: Red Sails - Cool Regime



Variety: Red Sails - Warm Regime



APPENDIX VIII: SUB-TRIAL (10 cm pots) - GROWING MEDIA ANALYSES

Growing Media Analyses* for week 35 potting (plants grown warm)

	At Potting	3 weeks	5 weeks	7 weeks	9 weeks	11 weeks
pH	5.3		5.1	5.4	6.0	6.0
Conductivity (EC) μScm^{-1}	444		363	260	147	219
Ammonium-Nitrogen (NH_4)	138		21	3	1	1
Nitrate-Nitrogen (NO_3)	153		119	96	31	85
Phosphorus (P)	79		50	38	18	26
Pottasium (K)	157		157	118	60	133
Magnesium (Mg)	42		59	41	17	25
Calcium (Ca)	56		106	75	40	58
Sodium (Na)	29		56	48	53	60
Chloride (Cl)	43		83	79	71	71
Sulphate (SO_4)	429		264	155	120	102
Copper (Cu)	0.06		0.06	0.10	0.23	0.66
Manganese (Mn)	0.27		0.29	0.20	0.08	0.22
Zinc (Zn)	0.14		0.20	0.29	0.90	0.88
Iron (Fe)	1.50		0.49	2.75	4.06	6.26
Boron (B)	0.48		0.49	0.39	0.38	0.66

*Water available - extractable analysis

APPENDIX VIII

Growing Media Analyses* for week 34 potting (plants grown cool)

	At Potting	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks
pH	5.3	5.4	5.4	5.6	6.1	6.1
Conductivity (EC)μScm-1	485	222	182	129	211	191
Ammonium-Nitrogen (NH_4)	126	26	1	1	1	1
Nitrate-Nitrogen (NO_3)	122	70	54	42	55	60
Phosphorus (P)	72	31	20	17	23	21
Pottasium (K)	126	89	66	68	85	96
Magnesium (Mg)	31	28	27	17	31	21
Calcium (Ca)	53	53	53	34	70	50
Sodium (Na)	23	36	41	34	60	55
Chloride (Cl)	33	55	74	38	81	55
Sulphate (SO_4)	305	162	136	86	178	99
Copper (Cu)	0.07	0.06	0.06	0.06	0.15	0.74
Manganese (Mn)	0.20	0.08	0.08	0.06	0.15	0.30
Zinc (Zn)	0.20	0.16	0.08	0.32	0.77	1.18
Iron (Fe)	1.26	0.81	0.25	2.26	4.33	5.76
Boron (B)	0.06	0.81	0.41	0.32	0.39	0.59

*Water available - extractable analysis

APPENDIX IX: SUB TRIAL (10cm pots) - COLOUR PLATES

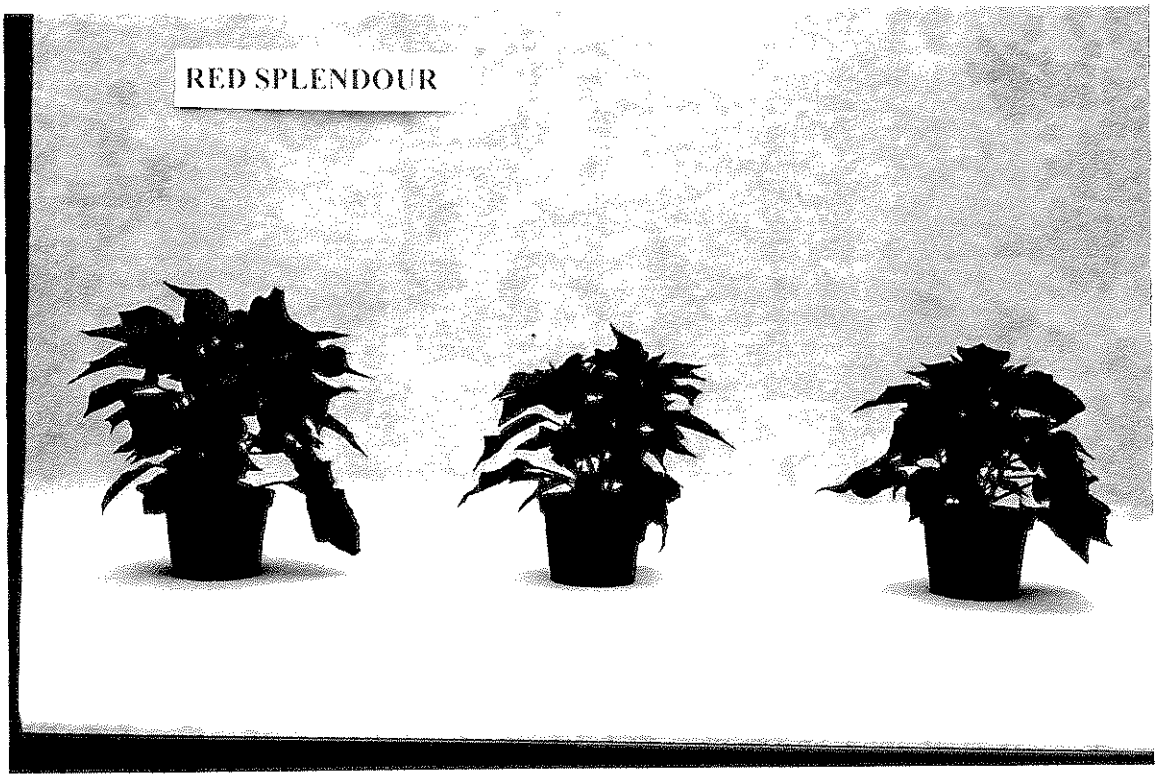
Plate 1: Comparison of Sub-Trial Treatments for Cortez (top, 22 plants/m^2; bottom 26 plants/m^2; left, week 35 warm; middle, week 35 cool; right, week 34 cool).

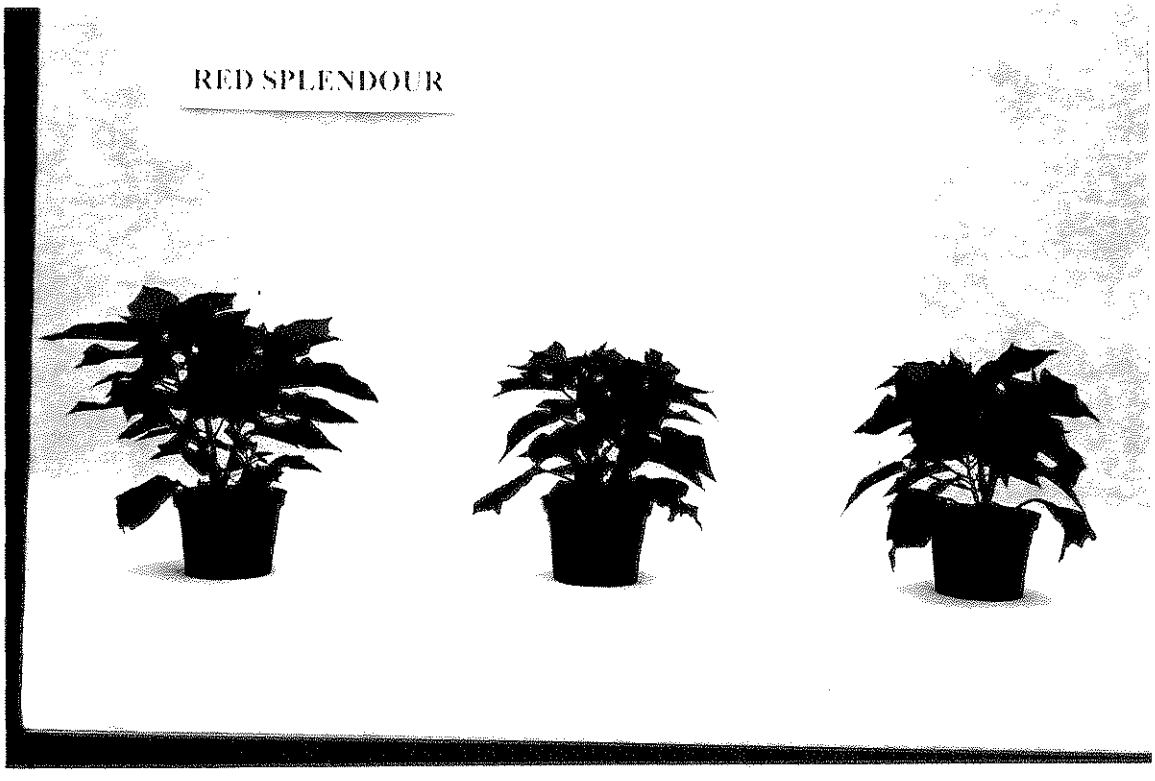
APPENDIX IX: Sub Trial (10cm pots) - Colour Plates

Plate 2: Comparison of Sub-Trial Treatments for Freedom (top, 22 plants/m^2; bottom 26 plants/m^2; left, week 35 warm; middle, week 35 cool; right, week 34 cool).

APPENDIX IX: Sub Trial (10cm pots) - Colour Plates

Plate 3: Comparison of Sub-Trial Treatments for Red Splendour (top, 22 plants/m^2; bottom 26 plants/m^2; left, week 35 warm; middle, week 35 cool; right, week 34 cool).





APPENDIX IX: Sub Trial (10cm pots) - Colour Plates

Plate 4: Comparison of Sub-Trial Treatments for Ria (top, 22 plants/m^2; bottom 26 plants/m^2; left, week 35 warm; middle, week 35 cool; right, week 34 cool).

APPENDIX IX: Sub Trial (10cm pots) - Colour Plates

Plate 5: Comparison of Sub-Trial Treatments for Sonora (top, 22 plants/m^2; bottom 26 plants/m^2; left, week 35 warm; middle, week 35 cool; right, week 34 cool).

APPENDIX X: NEW CULTIVARS - CULTURAL DETAILS

SITES

1. H Evans, Europa Nursery, Hadlow, Kent.
2. H & H, Gore Road, New Milton, Hants.
3. Oakheart Ltd, Stapleton, Leicestershire.
4. Tyson and Colleta, Hull, Yorkshire.

Site	**1**	**2**	**3**	**4**
Potting Week	32	32	31	31
Pot Size cm	13	13	13	13
Compost	Sinclair	SHL	Bullrush	Bullrush
Pinch week	33	34	34	33
Spacing half	wk 38 11.2m^2	wk 35 30m^2	wk 46 20m^2	wk 35 20m^2
Spacing final	wk 47 10m^2	wk 39 11m^2	wk 44 10m^2	wk 43 8m^2
Lighting day extension on /night break off		wk 37 wk 39	to wk 39	none
Assimilation	wk 32 to wk 38		when required	
Temperature:				
1. Potting:				
day	20°C	20°C	20°C	22°c
night	22°C	20°C	20°C	22°C
vent	+ 2°C	+ 2°C	+ 2°C	+ 25°C
2. Growing on:				
day	18°C	18°C	20°C	21°C
night	19°C	19°C	20°C	21°C
vent	+ 2°C	day 19°C	+ 2°C	24°C
3. Initiation:				
day	17°C	17°C	20°C	18°C
night	18°C	19°C	20°C	19°C
vent	+ 2°C	day 19°C	+ 2°C	21°C

CONTINUED

CONTINUED

4. After initiation:				
day	20°C	17°C	17°C	18°C
night	21°C	19°C	17°C	18°C
vent	+ 2°C	day 18°C	+ 2°C	20°C
drop		4°C 2 hrs		
5. To finish:				
day	14°C	18°C	17°C	16°C
night	14°C	19°C	17°C	16°C
vent	+ 1°C	20°C	+ 2°C	18°C
drop		no drop		
CO_2	-	to 450 ppm	-	-

PGR Application

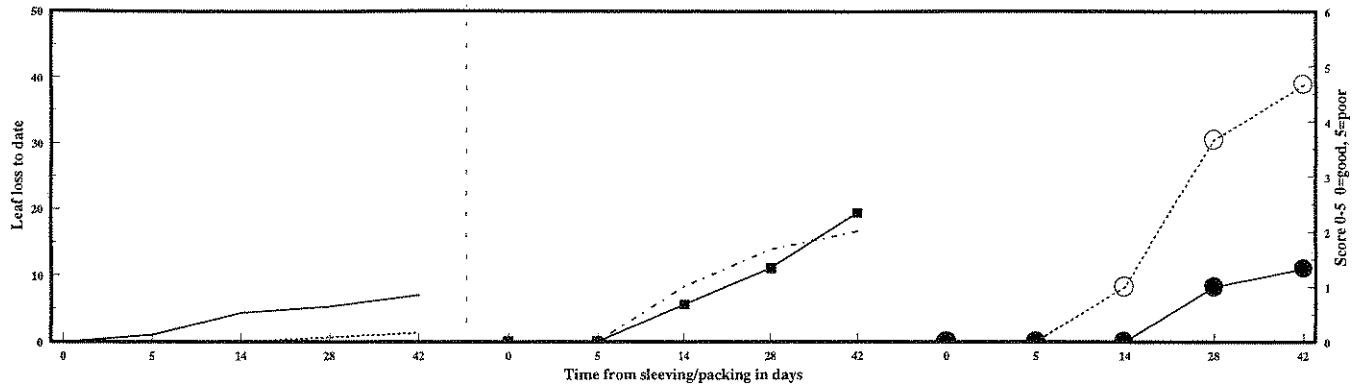
Material	CCC46%	CCC62%	ccc46%	CCC
Rate	3 ml/l	1 ml/l	1 ml/l	
Variety:				
1. Cortez		-	x 1	--
2. Freedom	x 3	x 2	-	-
3. Lilo	x 6	x 5	x 2	-
4. Monet		x 7	x 5	x 2-
5. Picacho		x 2	x 1	- -
6. Red Baron	x 5	x 2	x 2	-
7. Red Sails	x 5	x 5	x 2	-
8. Red Splendour	x 3	x 1	-	-
9. Sonora			x 1	--
10. Success	x 5	x 2	x 2	-

The main differences were the use of assimilation lighting in weeks 32 to 38 on site 1 instead of ordinary incandescent lights for day extension/night break, the use of CO_2 on site 2 and on site 4 no Cycocel was applied to any of the plants.

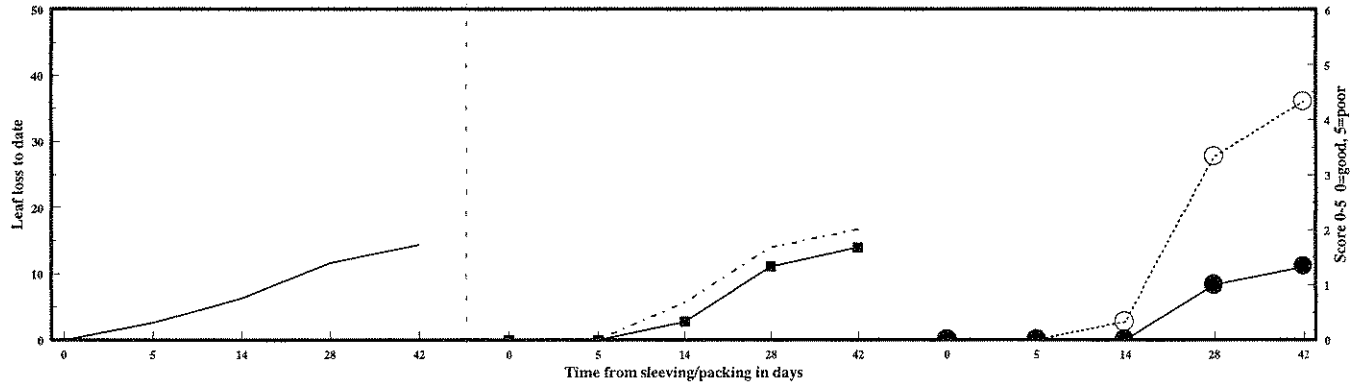
APPENDIX XI: NEW CULTIVARS - SHELF-LIFE RESULTS

Variety: Sonora

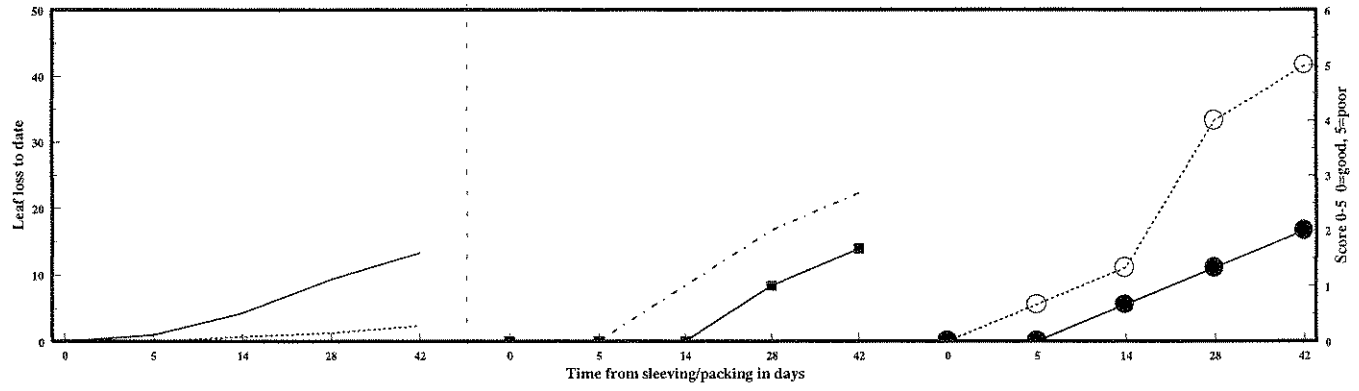
Grower 1



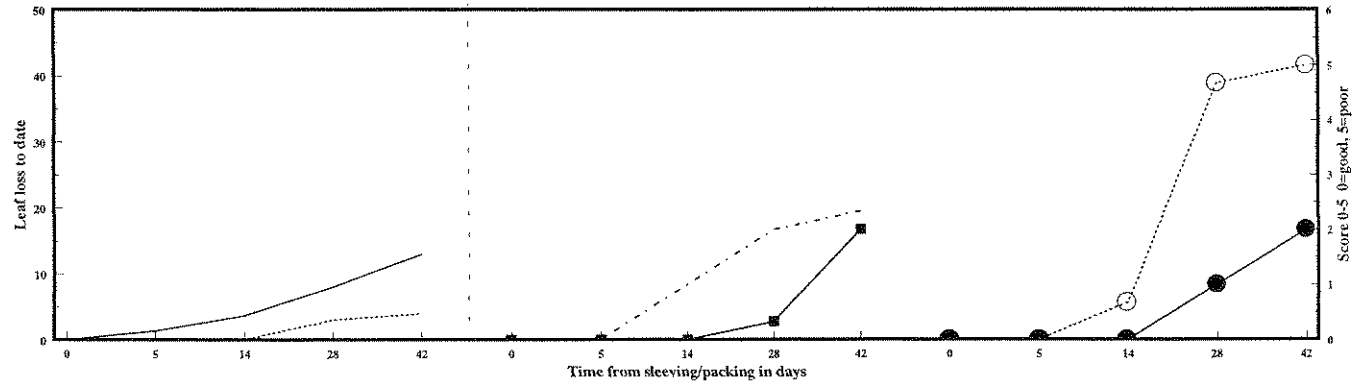
Grower 2



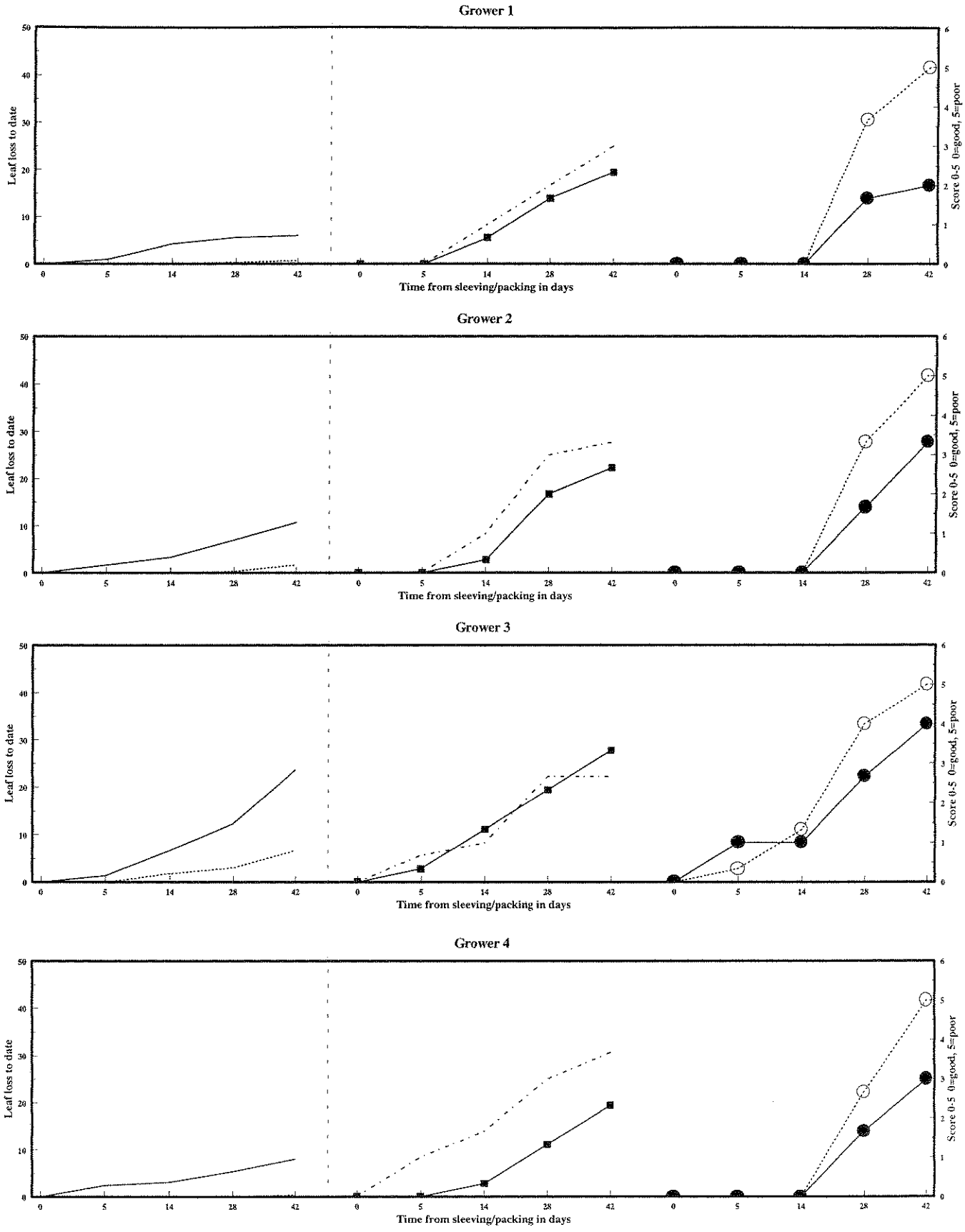
Grower 3



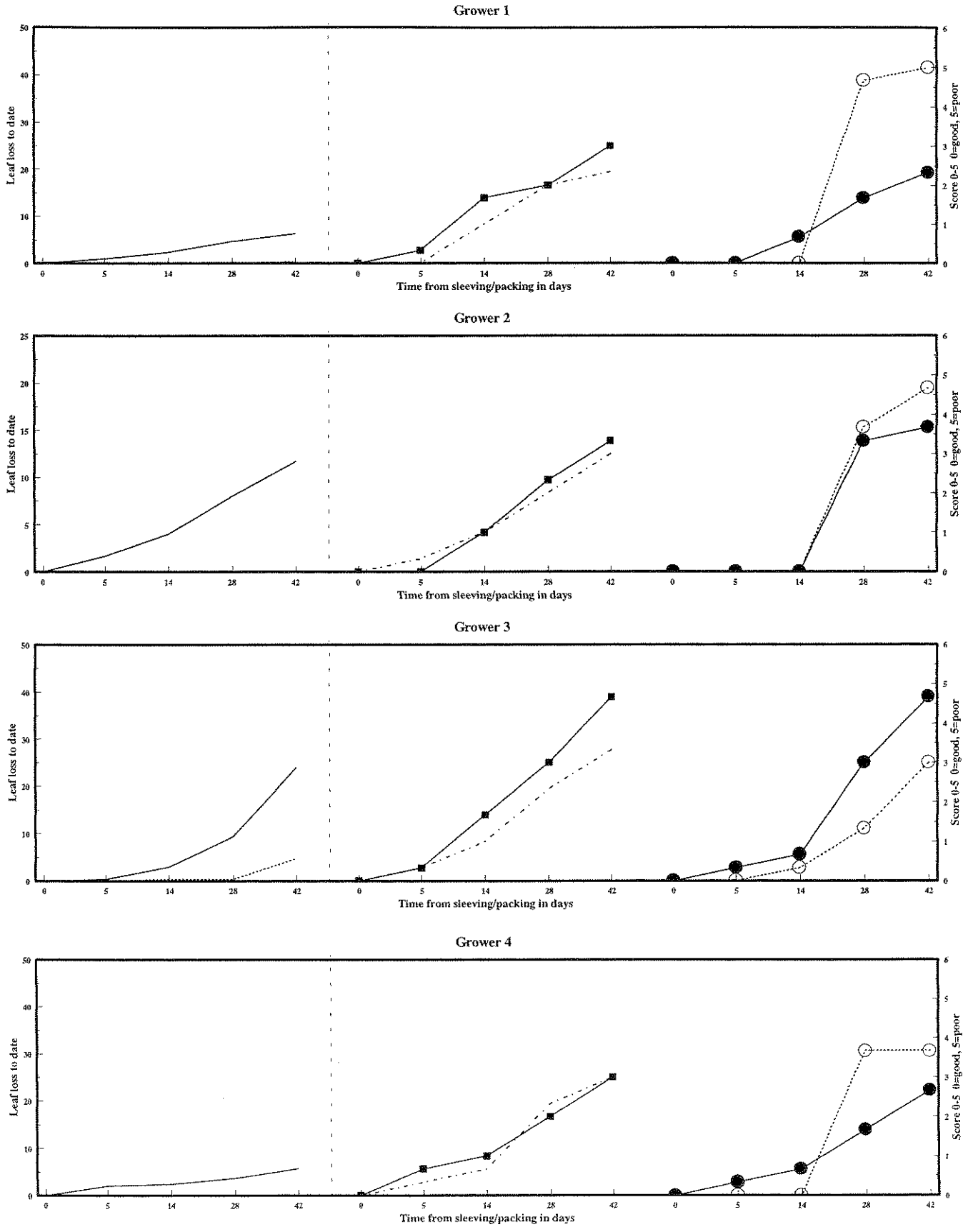
Grower 4



Variety: Cortez

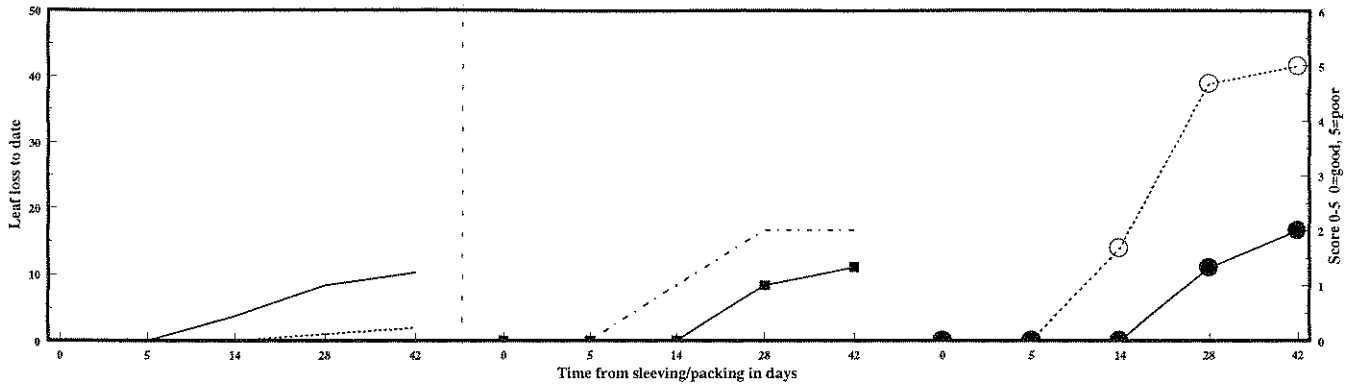


Variety: Success

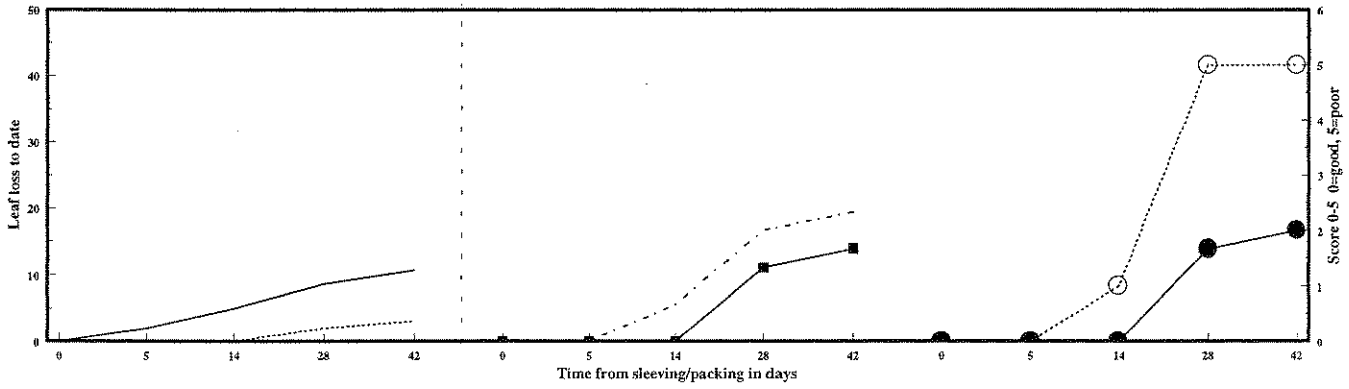


Variety: Red Splendour

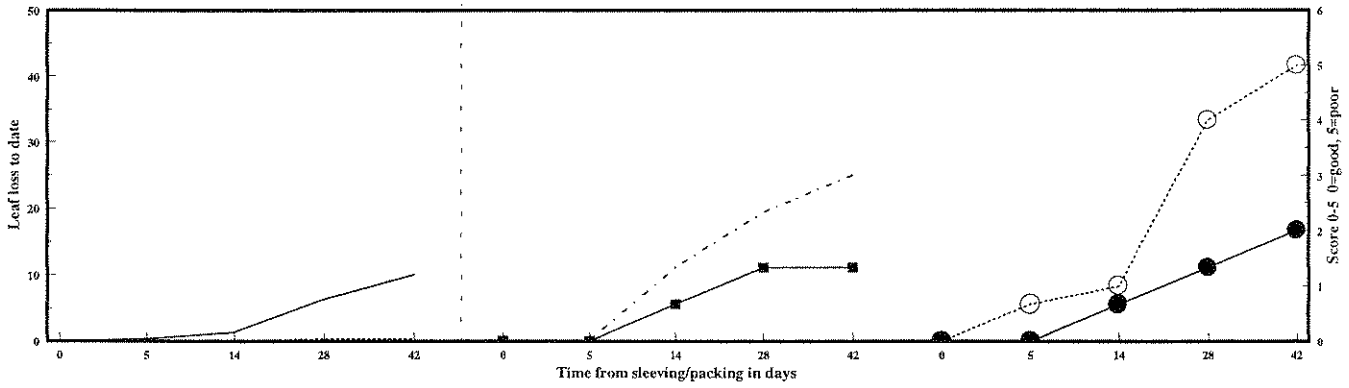
Grower 1



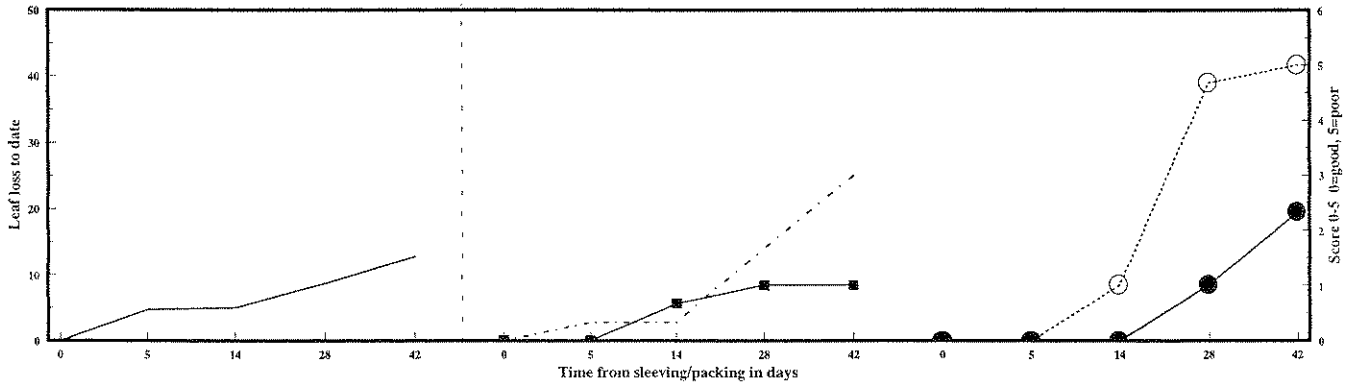
Grower 2



Grower 3

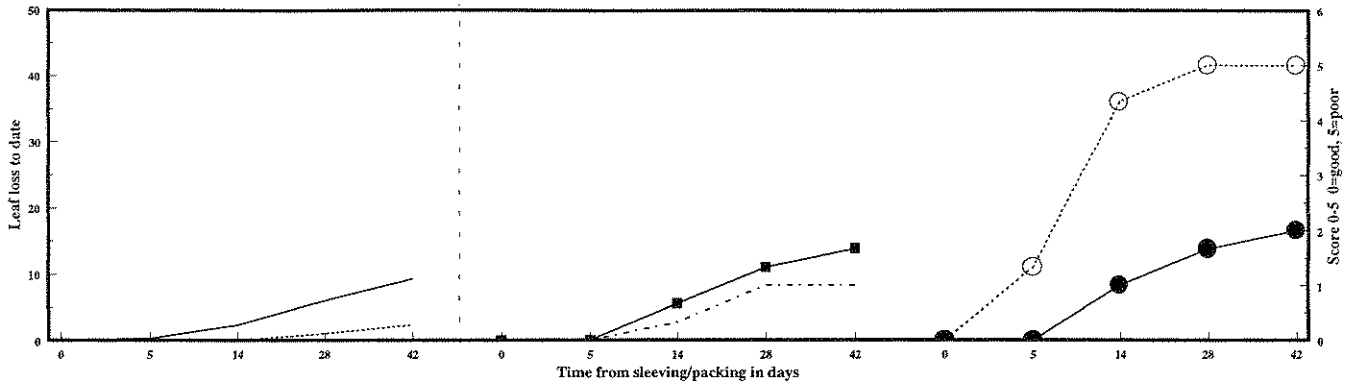


Grower 4

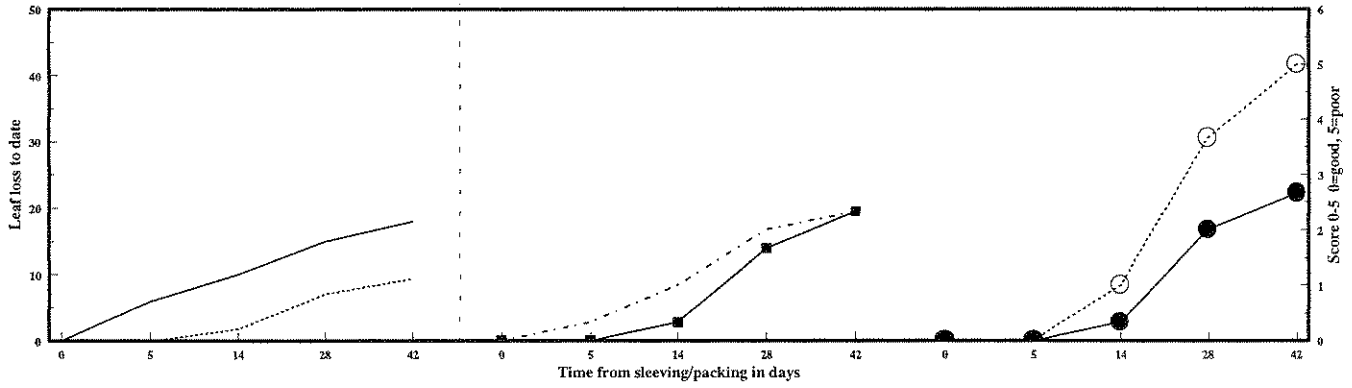


Variety: Freedom

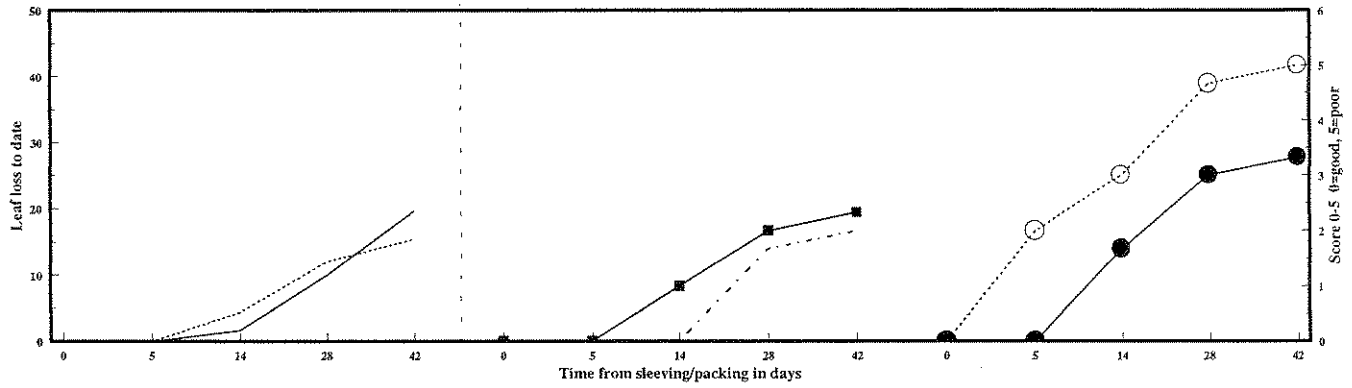
Grower 1



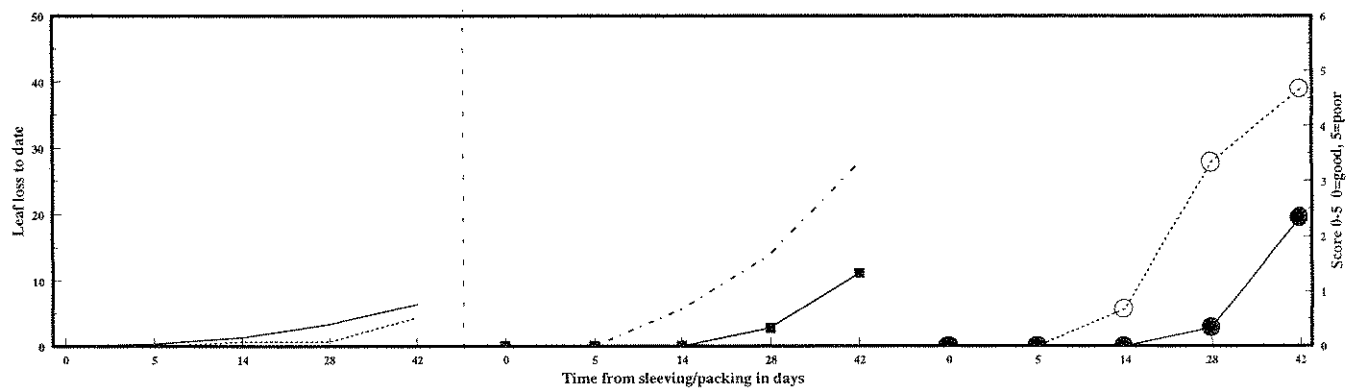
Grower 2



Grower 3

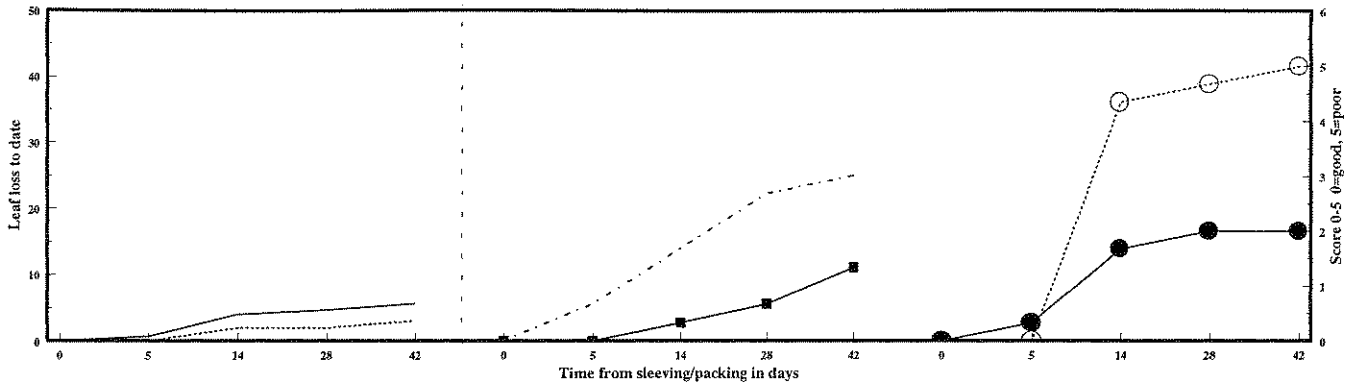


Grower 4

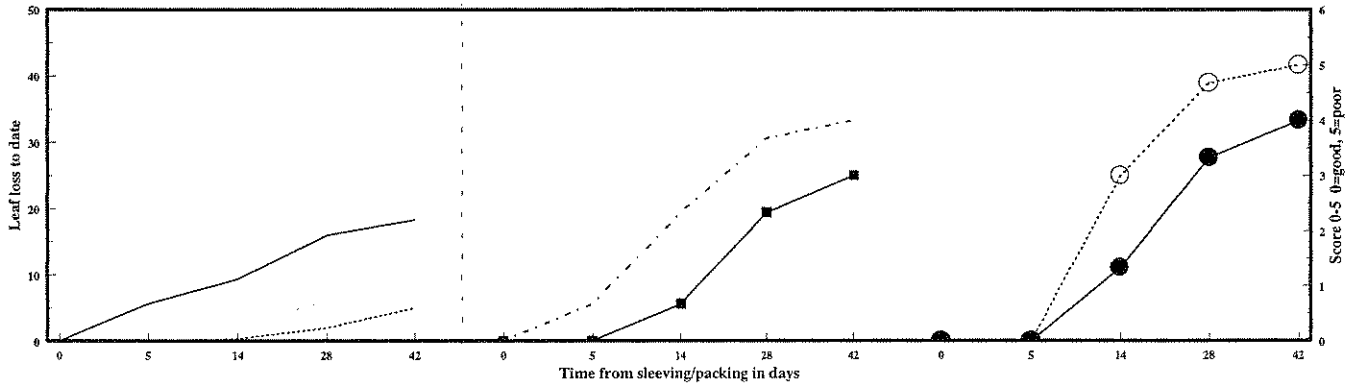


Variety: Red Sails

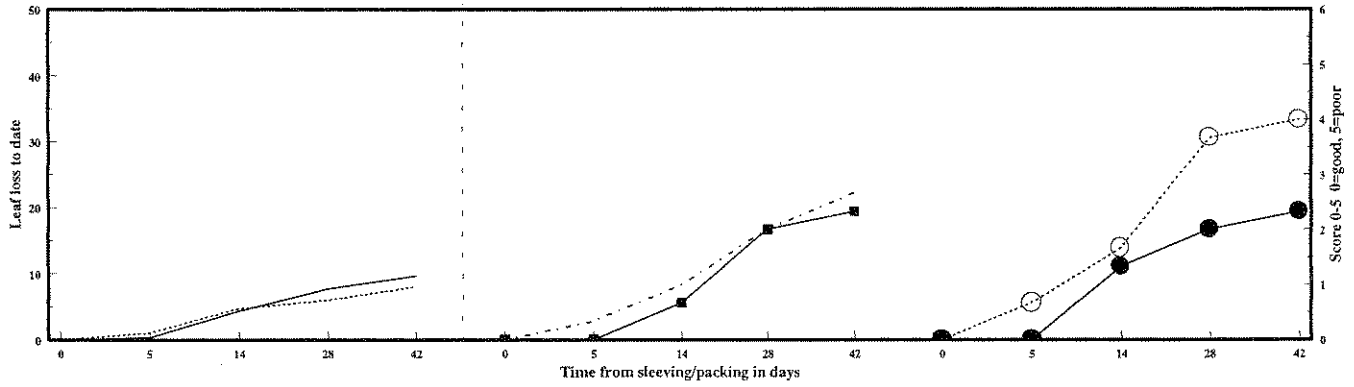
Grower 1



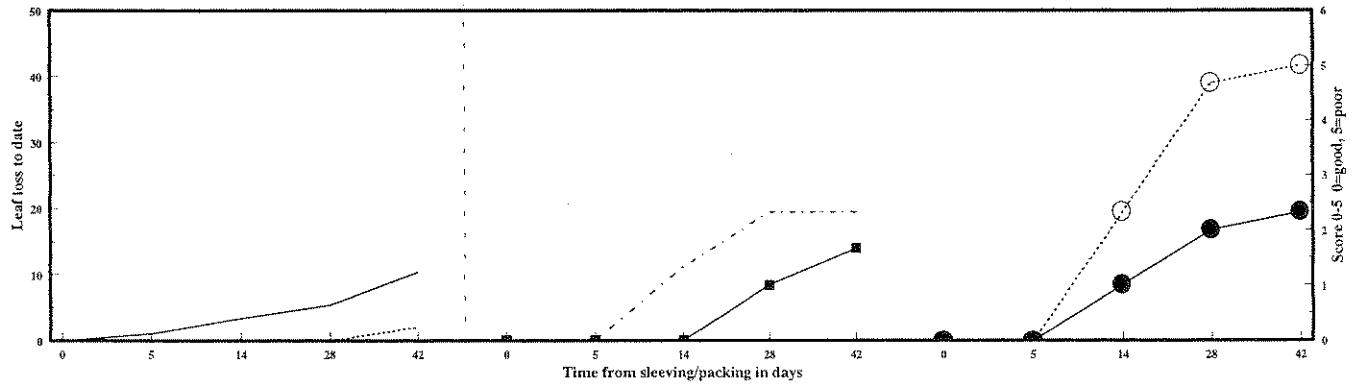
Grower 2



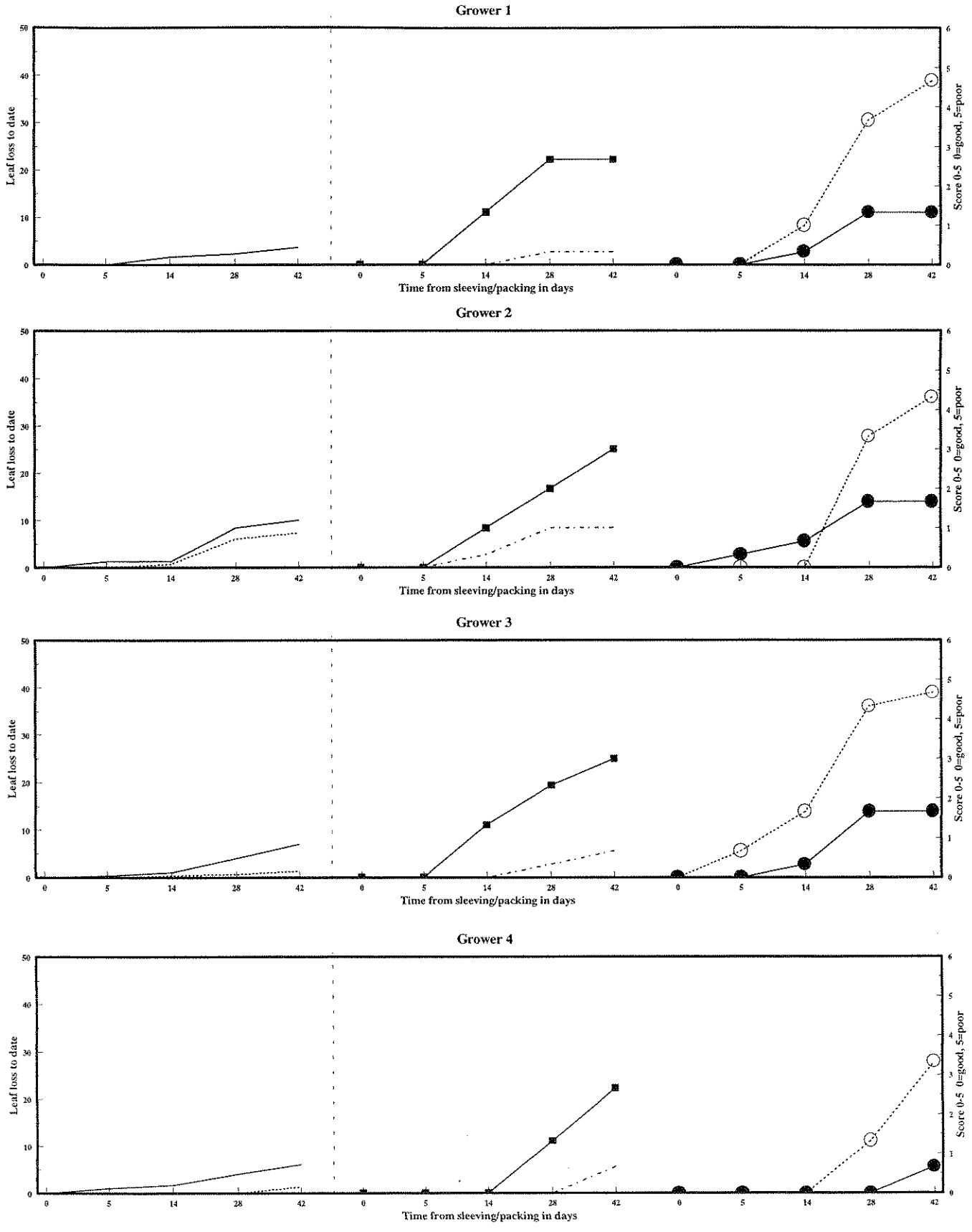
Grower 3



Grower 4

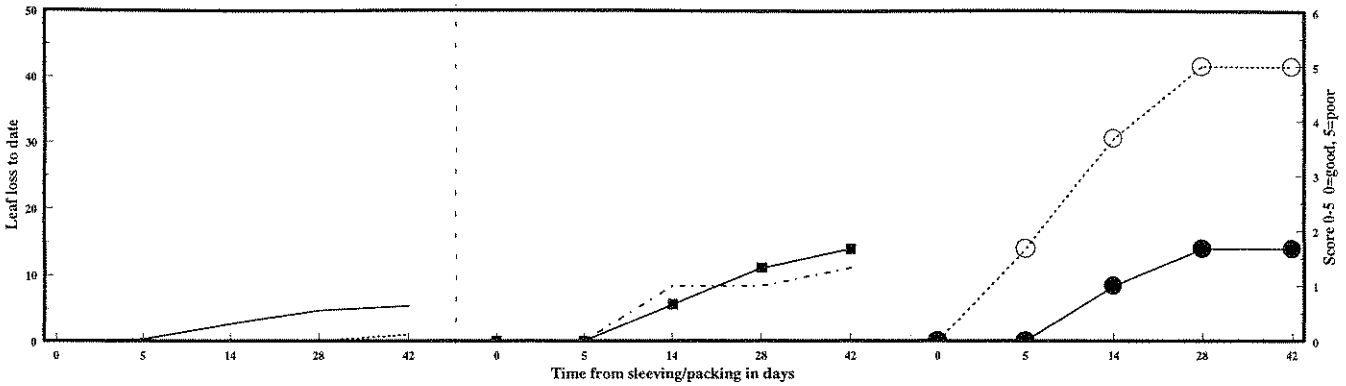


Variety: Monet

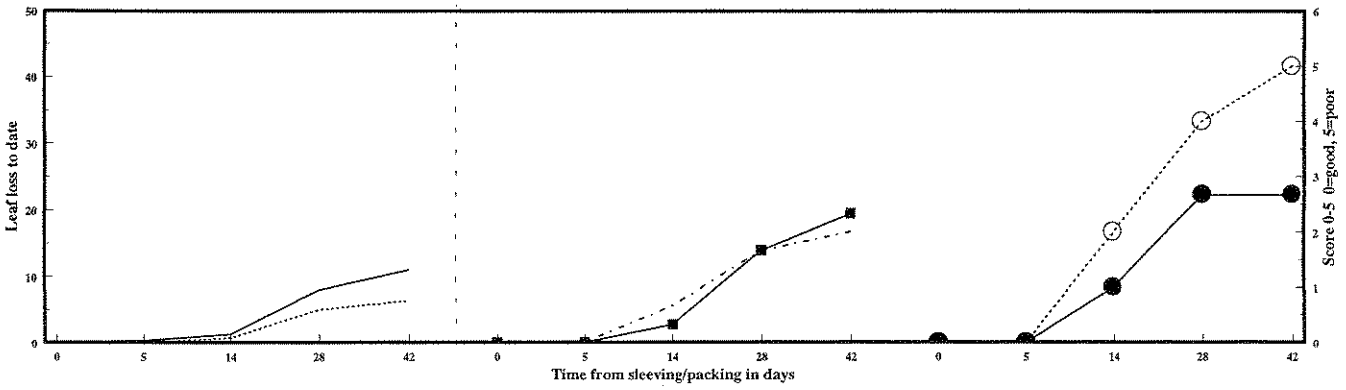


Variety: Lilo

Grower 1



Grower 2



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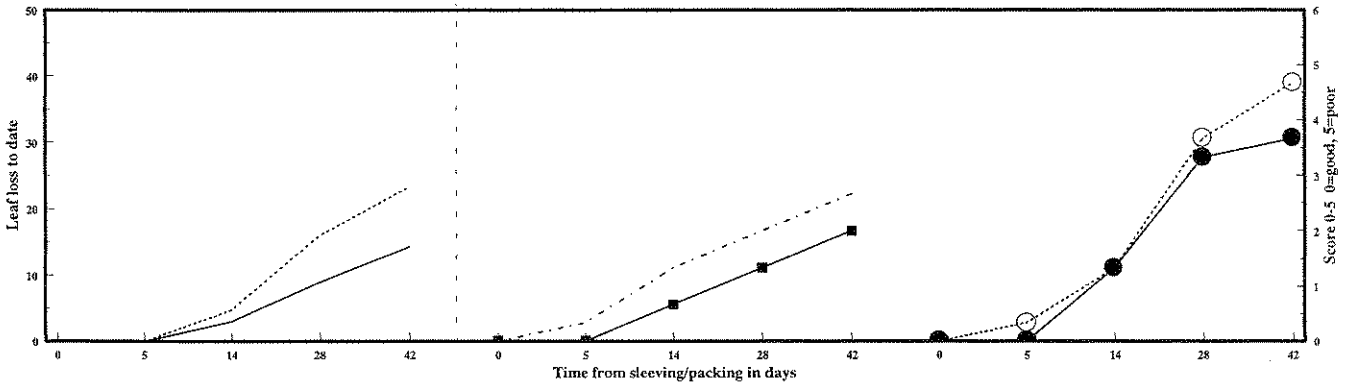
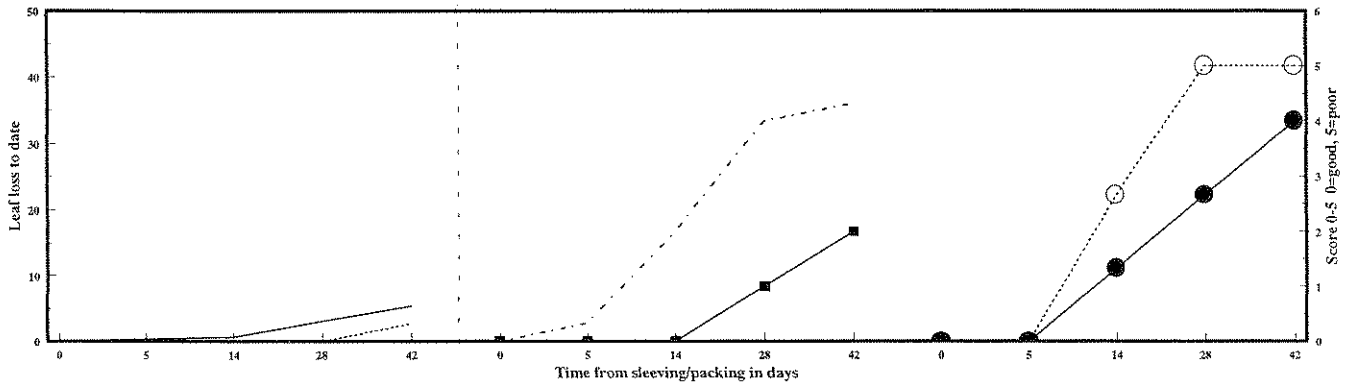
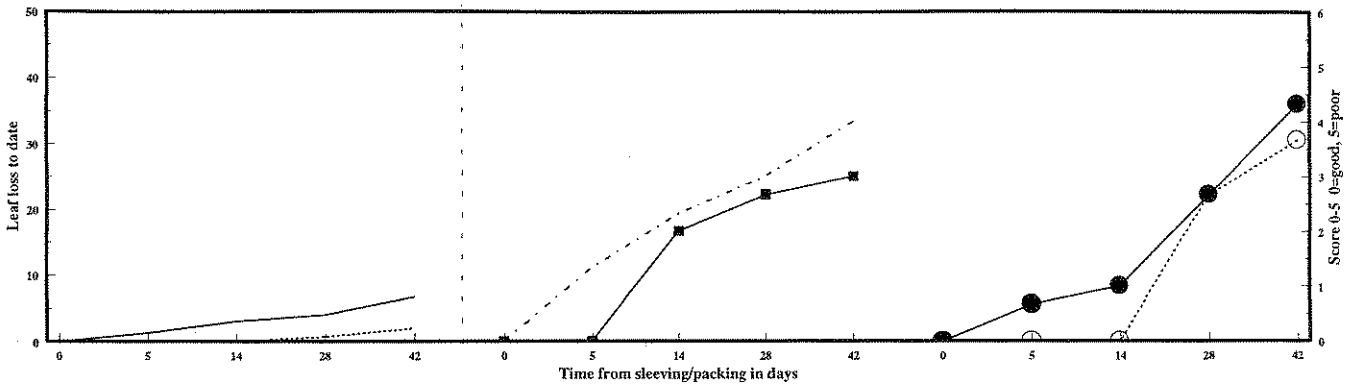


Grower 4

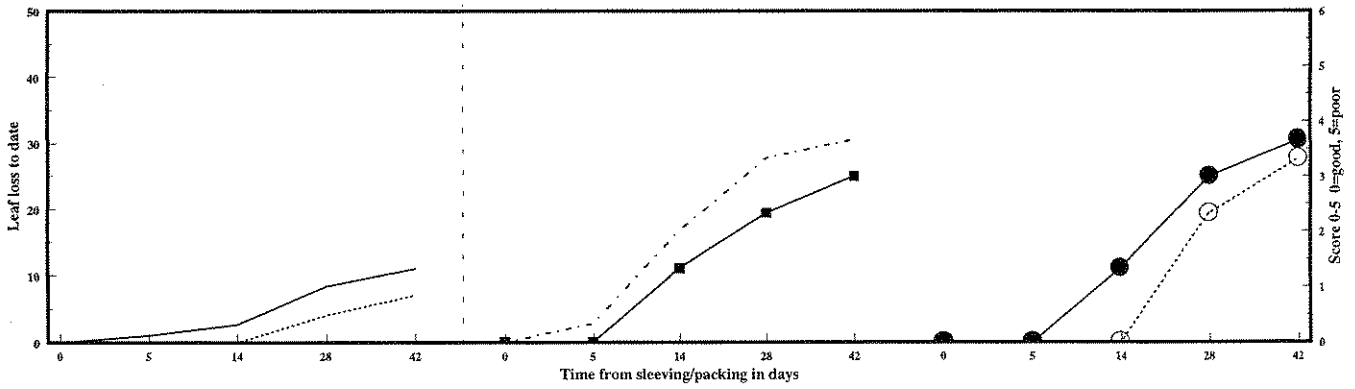


Variety: Red Baron

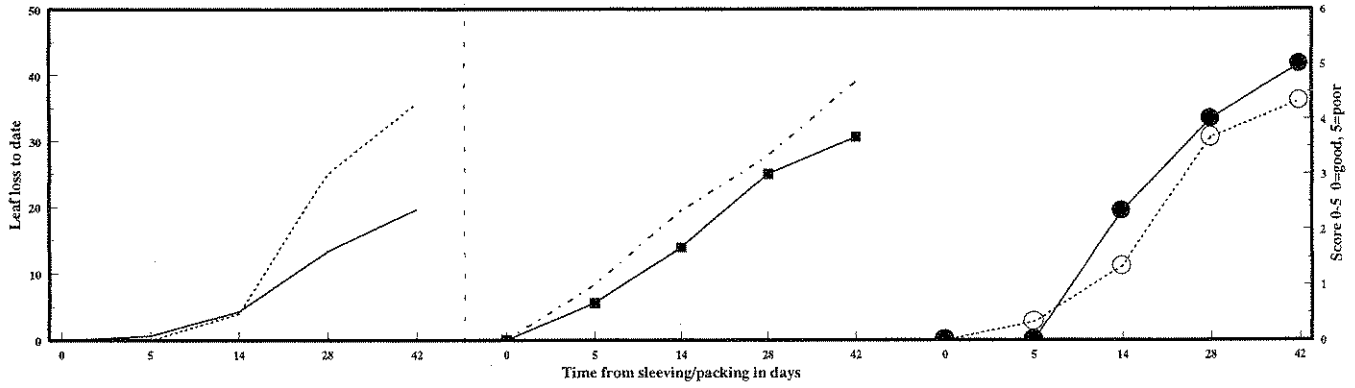
Grower 1



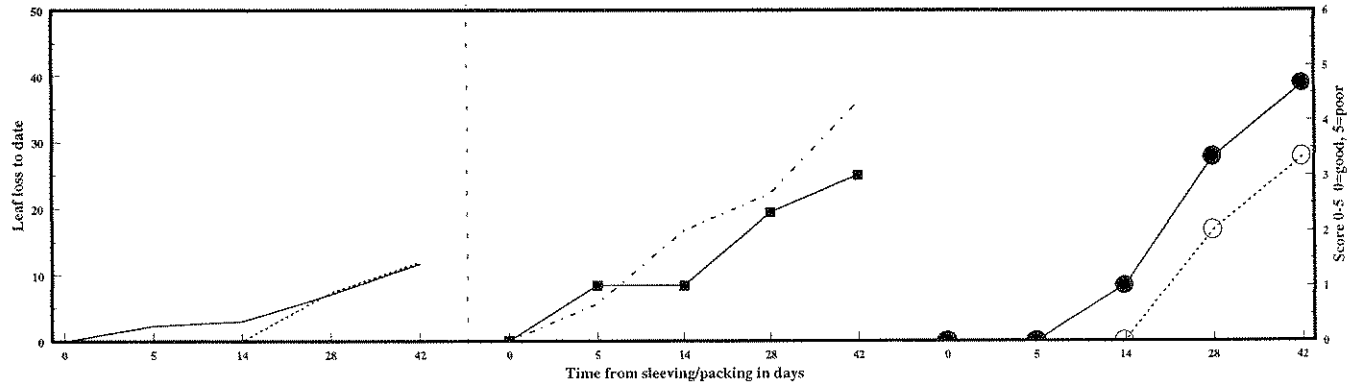
Grower 2



Grower 3

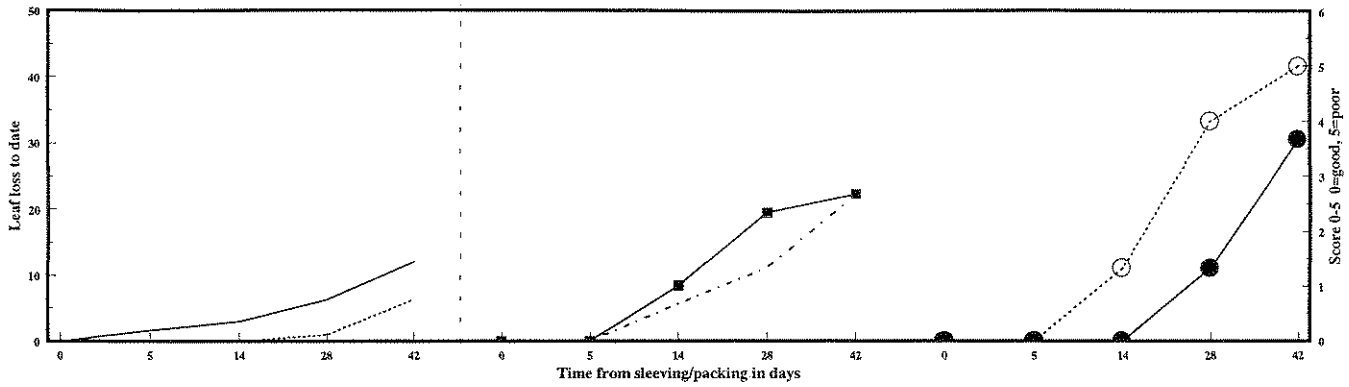


Grower 4

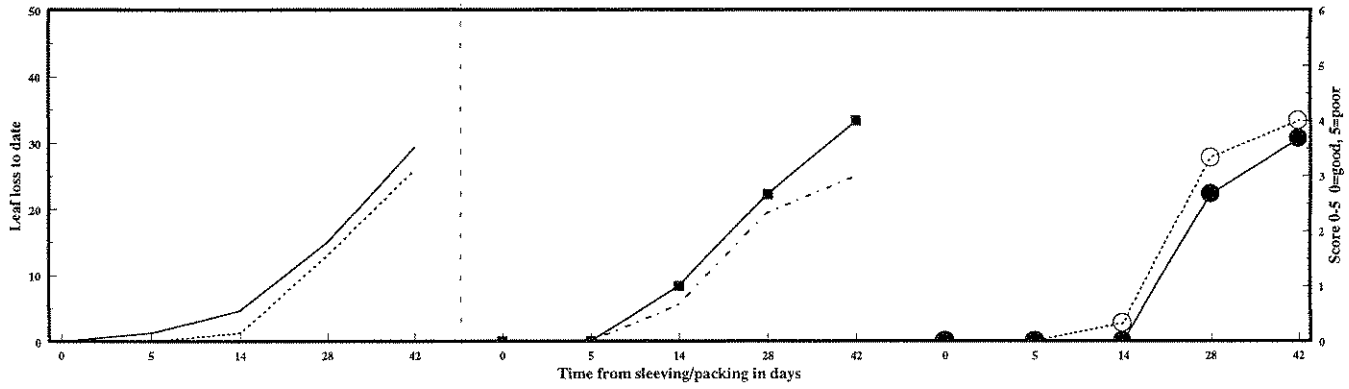


Variety: Picacho

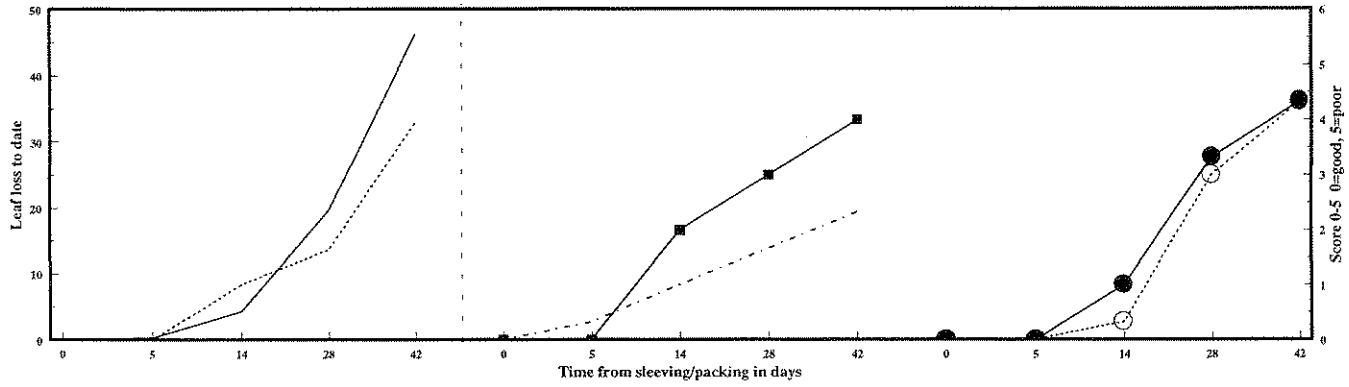
Grower 1



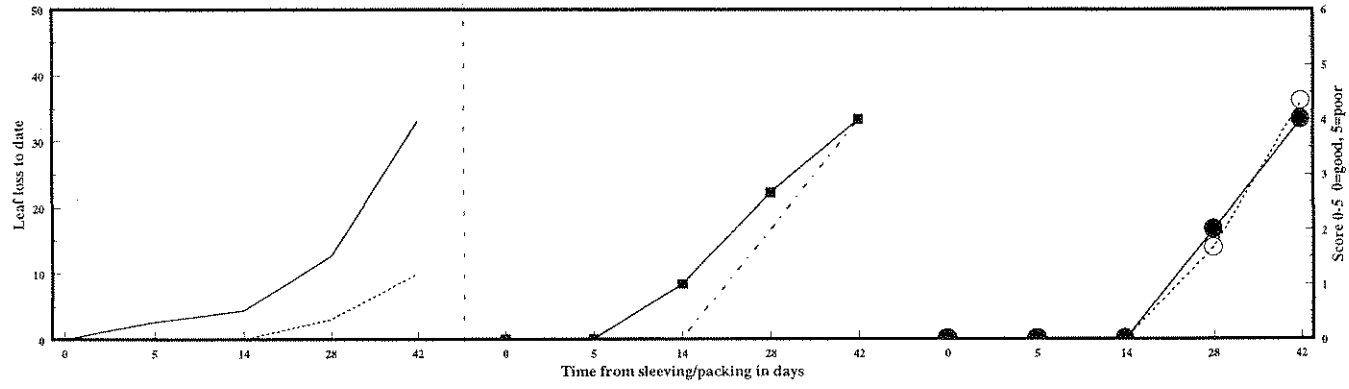
Grower 2



Grower 3



Grower 4



APPENDIX XII: CONTRACT, TERMS AND CONDITIONS

HORTICULTURAL DEVELOPMENT COUNCIL R & D CONTRACT
Contract Number: PC 71c
(extension for a second year)
Contract Date: 4.10.96

1. This is a contract between the Horticultural Development Council (hereinafter called the 'Council') and HRI and ADAS (hereinafter called the 'Joint Contractors').

2. It is for carrying out a research and development project and delivering the results obtained to the Council.

3. Title of the project

POINSETTIA: AN INVESTIGATION OF THE GROWTH AND SHELF-LIFE PERFORMANCE OF NEW POINSETTIA CULTIVARS AT TWO DIFFERENT TEMPERATURES AND AN ASSESSMENT OF THE COSTS OF LABOUR AND ENERGY IN PRODUCTION

Details of the project are listed in the Schedule which is attached.

4. Start date and duration

This contract will commence on 1 July 1995 and will last for 2 years (11 months pa).

5. Reporting

The report for the first year of the project will be supplied to the Council no later than 31 May 1996. The final report (including all the results presented in the first year report as well as the 1996/97 results and an overall summary) will be supplied to the Council no later than 31 May 1997.

HRI and ADAS will be responsible for producing the experimental reports for their parts of the project and HRI will be responsible for combining the experimental reports in a single annual/final report.

6. The Joint Contractors agree to attend such project review meetings that the Council deem appropriate.

7. The Joint Contractors agree to supply one written item per year about the project for HDC Project News, (or an appropriate technical publication agreed with the HDC), and to attend one conference or field-day per year to present results.

SCHEDULE FOR
PC 71c
(extension for a second year)

1. BACKGROUND AND COMMERCIAL OBJECTIVE

Year 1 (1995)

As for PC 71c (section 2).

Year 2 (1996)

In 1995 the HDC trial PC 71c examined the potential for growing commercial crops of 13 cm Poinsettias at lower temperatures than currently applied by growers. A number of cultivars which could be successfully produced at cooler temperatures were identified in this trial and potential energy savings were demonstrated. Up to a 40% saving in heating cost was calculated as a result of the temperature treatments employed for the trial (cool growing: 3°C reduction in base heating set point) and significant reductions in the use of chemical plant growth regulators were also achieved. However, above average light levels were recorded in the 1995 growing season and conditions for the production of Poinsettias were very favourable. Concern was raised about the repeatability of these promising results in a different growing year, especially in relation to cool growing which is likely to be significantly influenced by external day/night temperatures and light levels. Therefore, it is proposed that the production of commercial Poinsettias at cooler production temperatures will be re-examined in 1996. The cultivars which were deemed to be suitable for production at cooler temperatures will be re-evaluated.

Plant spacing can have a major influence on the profitability and quality of the crop. Potential may exist for plants to be grown at cooler regimes with closer plant spacings which would increase the return per unit area for growers. Two spacing treatments will be included within the trial to investigate the potential for increasing grower returns through increased production per unit area. Furthermore, survey work conducted by ADAS in the autumn of 1995 suggested that spacing and plant canopy development could affect leaf-drop in shelf-life; lower light levels causing more rapid leaf drop. This needs to be examined further and would compliment the study on plant spacing. A shading treatment will also be included to reduce light receipt by approximately 20-30%. This treatment will simulate light levels expected in the northern parts of the UK. Growers will then be given the opportunity to compare plant growth and maturity under two different light levels, reflecting production in both southern and northerly latitudes.

As greater numbers of Poinsettias are grown as 10 cm pot plants in the UK, it is important that the effect of cooler temperature production and spacing is also evaluated on this crop. The production of this crop occurs later in the year and the natural solar energy gain will be lower, hence the results from the treatments may be different from those observed with 13cm plants.

Commercial trials will also evaluate a greater range of Poinsettia cultivars and these will then be tested at Efford for their shelf-life and longevity. Plants from the main trial at Efford will also be subjected to a range of shelf-life treatments to identify effects of production treatment on shelf-life and effect of shelf-life environment on plant longevity.

Commercial Objectives

i. To investigate the use of cooler temperatures for the production of Poinsettia which would potentially produce savings in energy costs and reduce the reliance and use of chemical plant growth regulators.

ii. To investigate the potential for manipulation of plant spacings to achieve higher plant densities and thus greater economic returns per unit area.

iii. To assess the effect of reduced light receipt by the crop on subsequent plant growth and development, specifically with regard to growing Poinsettias at cooler temperatures.

iv. To examine a range of cultivars and evaluate the potential for commercial production as both 13 cm and 10 cm pot plants.

v. To assess the effect of different handling and marketing procedures on the shelf-life of Poinsettia in both shelf-life and 'home-life'.

vi. To continue to evaluate a range of new Poinsettia cultivars for production in the UK and their performance in shelf-life.

2. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

As for PC 71c (section 3).

3. SCIENTIFIC AND TECHNICAL TARGET OF THE WORK

As for PC 71c (section 4).

4. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

As for PC 71c (section 5).

5. DESCRIPTION OF THE WORK IN YEAR 2

The main element of the trial will be to evaluate selected Poinsettia cultivars for production in 13 cm and 10 cm pots under two different temperature regimes; 'standard', (warm growing as standard practice for growers in the UK) and a `cool' temperature treatment. Plants will all be grown using proprietary peat based growing media and subsequent liquid feeding.

Plants will be brought in during weeks 28 and 30 `cool' and week 31 'standard' (13 cm pots), and weeks 34 and 35 'cool' and week 35 'standard' (10 cm pots). Plants would be grown on at either present commercial temperatures, or a set point of 15°C day/night and vent 17°C throughout production, although during the summer months the average temperature may be higher.

Two plant spacing treatments will be incorporated for both the 13 cm and 10 cm pot production. A 'standard' spacing will reflect current commercial practices (10/m^2 for 13 cm and 22/m^2 for 10 cm) whilst a second spacing would be employed to grow plants at an increased number per unit area (12/m^2 for 13 cm and 26/m^2 for 10 cm). The trial will be divided so that half of the plants would be grown under a permanent 25-30% shade material to reflect light levels received at more northern latitudes in the UK.

Plants will be pinched 7-10 days after potting to achieve a minimum of 5-6 breaks (13 cm) and 4-5 breaks (10 cm) with the aim to grow all plants to market specification (height range 28-32 cm [13 cm] and 20-25 cm [10 cm] with minimum of 4-5 well coloured undamaged bracts).

Growth regulation will be through cycocel application as necessary for each variety - under guidance from the Project Co-ordinator. All plants will be grown as a natural season crop.

Experiment Design

Effect of production temperature on plant growth and development:

For 13 cm pot production

a) with shading examination

3 cultivars
x
2 spacings (10 and 12/m^2)
x
2 shade treatments (ambient and 25-30% shade)
x
3 potting dates (weeks 28 and 30 'cool' regime and week 31 'standard' regime)

36
x
2 replicates

72 plots

b) without shading examination

1 cultivar
x
2 spacings (10 and 12/m²)
x
3 potting dates (weeks 28 and 30 `cool' regime and week 31 'standard' regime)

6
x
2 replicates

12 plots

Total 84 plots

There will be 18 plants per plot at final spacing of which 8 plants will be recorded and 6 of these will enter shelf-life.

For 10 cm pot production

6 cultivars
x
2 spacings (22 and 26/m²)
x
3 potting dates (weeks 34 and 35 `cool' regime and week 35 'standard' regime)

36 plots
x
2 replicates

72 plots

Total 72 plots

There will be 22 plants per plot at final spacing of which 8 plants will be recorded.

Shelf-life

13 cm plants only would be taken for assessment in shelf-life. Plants from week 30/31 potting ('cool' and 'standard' temperatures) will be utilised for shelf-life assessments from each of the production treatments (x spacing and shading treatments). The shelf-life assessments will last for a period of six weeks. A detailed shelf-life test will include:

- Plants placed directly into shelf-life environment without placement into sleeves (control).

- Plants sleeved and boxed and transported for 3-4 hours in uncontrolled environment and held for 1, 3 or 6 days in controlled environment; no lights, 16°C D/N, RH 80%, before being unboxed and unsleeved and placed into simulated shelf-life environment.

  Plants displayed in controlled 'retail' environment with sleeves removed; 1000 lux for 12 hours, 20°C D/N, RH 60%.

28	plots from production treatments
x	
4	storage durations/treatments
112	plots (3 plants per plot)

Plants of each new cultivar will also be received from commercial holdings for shelf-life assessments - 10 cultivars x 4 nurseries x 3 plants per cultivar = 120 plants (see below).

Commercial Assessments:

Commercial trials will focus on the evaluation of new cultivars which will be assessed on four different commercial nurseries. Thirty plants from each site (3 plants of each cultivar) will be sent to HRI Efford for shelf-life assessments. Mr Harry Kitchener will be responsible for plant growth records on each of the four grower sites. Production techniques for each nursery will be recorded. This will include: media type, irrigation, nutrition, PGR use and application, temperature regime. Plant growth records will be taken upon the arrival of plant cutting material, 8 weeks post potting and again prior to marketing.

Records:

Efford Assessments:

For comparison between production temperatures ('cool' and 'standard' production).

At Potting • Record of cutting material quality and delivery

At 4 weeks after potting • Number of breaks and their habit

Marketing (* As a sub-plot record for 6 plants per plot)

- Plant height (from pot rim to top of foliage - unsleeved plant)
- Plant diameter (across widest width and at 90°)
- Number of shoots/breaks on each plant
- Number of heads on each plant and measurement of the maximum width of each bract
- Number of bracts per head on a plant *
- Number of green leaves per stem on each plant *
- Bract colour/disorders
- Foliage colour
- Cyathia score (0=none, 1=some, 3=moderate and 5=many prominent)
- Overall plant quality (0=umkt, 1=second grade and 3=grade I plant)
- Date of first colour per plant
- Date of first visible cyathia (per plant in plot)
- Date of first pollen showing (per plant in plot)
- Date of marketing

Media Analysis

- At potting
- Every 2 weeks from potting from each temperature regime

Plant Growth Regulation

- Total number applications
- Timing of applications

Shelf-life

- Plants will be recorded at marketing to have a record of plant quality before entering shelf-life and subsequently records would be done on days 1, 3 and 6 and then weekly for six weeks.

Records to include

- Number of leaves dropped
- Number of red bracts dropped
- Cyathia loss (0=none, 1=slight, 3=moderate and 5=complete loss)
- Mechanical damage (0=none, 1=slight, 3=moderate and 5=severe)
- Leaf colour records (upper and lower leaves)
- Bract colour and deterioration
- Overall plant longevity

Commercial Assessments:

- Description of plant cutting quality on receipt at each site
- Full record of growth production techniques and growing systems at each site
- Plant growth records at 8 weeks and at marketing stage to include where appropriate:

At 8 weeks	**At marketing**
Plant height	Plant height
No. of breaks	No. of breaks
Quality/uniformity	No. of bracts (inc. size)
	Plant diameter
	Cyathia score
	Plant quality/uniformity
	Date of first colour per plant
	Date of first visible cyathia
	Date of first pollen showing
	Date of marketing

6. STAFF RESPONSIBILITIES

Project Leader:	Dr David Hand, HRI Efford
Other HRI staff:	Mr Andrew Fuller, HRI Efford (until October 1996)
ADAS staff:	Mr Harry Kitchener, ADAS Huntingdon
Project Co-ordinator:	Mr Gary Shorland, Double H Houseplants

7. LOCATION OF YEAR 2 TRIALS

Main trial - HRI Efford, Lymington, Hants

Commercial trials - four grower holdings

M Tyson
Colletta & Son
Cheshire

S Bilbie
Oakheart Nurseries
Leics

J Hickmott
H Evans & Son
Kent

M Holmes
Double H Nurseries
Hampshire