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Period of investigation:	February 1994 - May 1994
Date of issue of report:	February 1996
No. of pages in report:	69
No. of copies of report:	9
This is copy no. 3:	Issued to Horticultural Development Council

CONTRACT REPORT

New Guinea Impatiens:
The potential for extending the growing season, improving plant production and shelf-life properties using cultural and chemical means

Part I (1994)
Effect of lighting and temperature

HDC PC80a

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AUTHENTICATION

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

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HDC PC80a

New Guinea Impatiens: The potential for extending the growing season, improving plant production and shelf-life properties using cultural and chemical means

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Commenced: February 1994

Completed: May 1994

Key words: New Guinea Impatiens, lighting, temperature, cultivars

1. RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

1.1 APPLICATION

The aim of this study was to examine the effect of supplementary lighting and temperature on the growth and flowering of a range of New Guinea Impatiens cultivars for early season production as a potted plant.

There was a strong effect of temperature on both the growth and flowering of New Guinea Impatiens. Warmer growing temperatures c. 25°C reduced time in production, but final plant quality was poorer and plants deteriorated rapidly in shelf-life assessments. In contrast, plants grown at 15°C were more compact and better suited for production in a 10 cm pot at 25 plants/m^2. However, plants took longer to reach marketing stage and were not as floriferous.

Supplementary lighting increased uniformity of flowering although production time was reduced by only 1.6 days in contrast to plants unlit. It appears that the benefit of supplementary lighting is small.

The Paradise series of New Guinea Impatiens was better suited to commercial production in a 10 cm pot at closer plant spacings (25 plants/m^2). Their more compact habit, uniformity and profusion of flowers was seen as an advantage.

1.2 SUMMARY

Potential exists for the production of New Guinea Impatiens to be extended, both earlier and later in the year as an indoor potted plant. However, the growth and flowering under natural conditions can become erratic in the early part of the year when light levels and outside temperatures are much lower.

Thus a research proposal was submitted to the HDC in 1994 to examine the effect of supplementary lighting and temperature on the growth and flowering of a range of New Guinea Impatiens.

The objective of the project was to examine the potential for the early season production of New Guinea Impatiens as a 10 cm pot plant targeting the Easter and Mother's Day markets. A wide range of older 'classical' types of New Guinea Impatiens cultivars were grown alongside cultivars selected from the new 'Paradise' series. In addition, the effect of cultural treatments on shelf-life was also assessed.

1.2.1 METHODOLOGY

Start Material

Plants were supplied as rooted cuttings from Blake Herbs and Flowers Ltd, and P A Moerman Ltd. Plants were potted in week 8, 1994.

Cultivars

Paradise Types	Others (Classical types)
Antigua	Anaea
Aruba	Danbee
Blue	Dunya
Bolero	Eurema
Cha Cha	Marpesia
Lanai	Rock
Lindyhop	Selenia
Maui	Vulcain

Treatments

Temperature/lighting treatments

1. 20°C without supplementary lighting
2. 20°C with 2500 lux supplementary lighting for 12 hours/day.
3. 15°C with 2500 lux supplementary lighting for 12 hours/day.
4. 25°C with 2500 lux supplementary lighting for 12 hours/day.

NB: Supplementary lighting provided by 400W SON/T lamps.

Shelf-life treatments

All plants were subjected to a simulated market run prior to shelf-life assessment of 3 weeks. Plants were placed into a simulated shelf-life environment; 20°C day/night temperature, with lighting at 1000 lux for 12 hours/day (0600hrs-1800hrs) provided by cool white fluorescent tubes, and at relative humidity of 65% ± 5%.

1.2.2 RESULTS

At 25°C plant size/growth decreased. Plant height and leaf area were reduced and root growth was very poor. Plants grown at this temperature reached marketing stage, in terms of flowering, much faster than the other treatments: 9.4 days earlier in comparison to plants grown at 15°C, and by 3.2 and 1.6 days for plants grown at 20°C without or with supplementary lighting respectively. Although plants were more floriferous, flower size and colour was poor. Leaf distortion was apparent on the cultivars Rock, Bolero, Cha Cha and Aruba, and all plants suffered in shelf-life, with rapid flower and bud drop.

At 15°C, although production time lengthened, plant quality was superior. Plant habit was more compact with greater branching and plant spread. Flowering and bud number were greatest at this temperature. Flowers were large, well presented on the plants, with good colour. Foliage was dark and the variegated cultivars stood out well (Eurema and Vulcain). Only two varieties, Marpesia and Aruba, suffered in the early stages of growth at this low temperature. Although longer in production, their compact habit meant some cultivars could be held at $30m^2$ up to marketing, increasing return per unit area which could potentially compensate for the longer production period.

At 20°C, a good comparison was visible between the lit and unlit crops. Supplementary lighting reduced production time by on average 1.6 days. Flowering and bud number increased under lights and plant growth was 'heavier'. Plant growth at 20°C was vigorous and early spacing was necessary to avoid 'leggy' plant growth.

In shelf-life, differences were apparent for crops lit and unlit. Supplementary lighting increased flowering in some cultivars and the ability to 'carry through' shelf-life. However, in some cases cultivars performed well in shelf-life without being lit during production. The lower light level in production appeared to condition plants prior to entering shelf-life.

The Paradise series of New Guinea Impatiens were superior in terms of their plant habit - more compact and uniform, and free flowering. Their habit was better suited to early season production as a 10 cm potted plant.

1.2.3 CONCLUSION

Early season production in a 10 cm pot (or 13 cm) should rely on cultivars from the Paradise series. Their habit suits production at higher densities without the need for chemical plant growth regulators. At 20°C, spacing of 25/m² should be the minimum allowed otherwise height control can become difficult. Lower temperatures produce more compact plants which can be grown nearer to 30/m² at final spacings.

For production throughout the early season months, January-April, supplementary lighting should be considered, to increase plant quality and flowering and to reduce production time. Although plant response to supplementary lighting in this trial was minimal, this can be attributed to a later potting in week 8. Earlier pottings would be produced in much poorer natural light conditions, and supplementary would potentially have a more advantageous effect.

Higher quality crops can be produced at lower temperatures near to 15°C. Dependent upon crop scheduling, production at such temperatures would reduce energy costs. Higher temperatures can be used to speed flowering, but plant quality will be reduced, the longer higher temperatures are applied.

Lighting can influence post-harvest performance and hence conditioning plants prior to marketing is important. Further study is needed to see if plants produced early in the season with supplementary lighting require a period of lower light to condition them before sale. Plants grown at lower temperatures, c. 15°C, have a better shelf-life. Therefore, reduction in temperature in the final weeks of production is recommended to condition plants before sale. However, New Guinea Impatiens remain 'vulnerable' in shelf-life, and can display rapid flower and bud drop, thought to be due to exposure to ethylene.

2. EXPERIMENTAL SECTION

2.1 INTRODUCTION

New Guinea Impatiens production and sale has grown rapidly over the past 5-10 years, and in Europe it is estimated near to 100 million plants are produced annually. With such rapid growth in production it is surprising that with the exception of earlier HDC study, PC 80, little research has been conducted on this crop, and in fact very little knowledge exists on the growth and flowering of New Guinea Impatiens in response to their growing environment.

The first introduction of commercial varieties into the UK was around 15 years ago. However, this introduction failed to make a great impact due to their small flower size, long stem internodes and poor branching. The first major advance in their popularity was the development of new cultivars by the breeder/propagator Mikklesens, who introduced the Sunshine Series about 10 years ago. Their improved flower size, colour range and habit made New Guinea Impatiens an instant success. From the Sunshine Series, the German propagator Ludwig Kientzler continued the improvement with the introduction and release of the Paradise series in 1991. This group was particularly compact, floriferous and early flowering. This was a major breakthrough and the Paradise series continues to dominate the UK market.

Breeding has produced a great diversity of cultivars, principally aimed for the late spring and summer markets. Potential exists for the production of New Guinea Impatiens to be extended, both earlier and later in the year as an indoor potted plant. However, the growth and flowering under natural conditions can become erratic in the early part of the year when light levels and outside temperatures are much lower. Previous trials in 1993 at HRI Efford funded by the HDC examined the use of supplementary lighting at a standard temperature of 18°C. There appeared to be little benefit from the use of supplementary lighting. However, research conducted in the USA revealed that flowering may be affected by a combination of temperature and light. Thus a research proposal was submitted to the HDC in 1994 to examine the effect of supplementary lighting and temperature on the growth and flowering of a range of New Guinea Impatiens cultivars. The project would concentrate on the early season production as a 10 cm pot plant. A wide range of cultivars would be assessed under different lighting and temperature regimes.

In addition, plants would be subjected to final assessment in a simulated shelf-life environment to assess the impact of production treatments on shelf-life. New Guinea Impatiens typically have a poor shelf-life, with plants rapidly dropping their flowers and buds. The use of supplementary lights and/or in combination with temperature could have an impact on shelf-life.

2.2 OBJECTIVES

- To evaluate the potential for early season production of New Guinea Impatiens as a 10 cm pot plant.
- To examine the effect of supplementary lighting and temperature on plant growth and flowering.
- To examine the effect of cultural treatments on a range of New Guinea Impatiens cultivars.
- To assess the performance of the cultivars selected in shelf-life and to determine the effects of cultural treatments on the shelf-life of New Guinea Impatiens.

2.3 MATERIALS AND METHODS

2.3.1 Site

The plants were grown on ebb and flood floors in four compartments of the multifactorial glasshouse "K" Block, at HRI Efford. Each compartment had a separate lighting/temperature treatment.

2.3.2 Start Material

Plants were supplied as rooted cuttings from Blake Herbs and Flowers Ltd, and P A Moerman Ltd. Plants were potted in week 8, 1994 (plants were due to be potted in week 1/2, but the original supplier failed to deliver plants and consequently potting was delayed).

Cultivars

Paradise Types	Others (Classical types)
Antigua	Anaea
Aruba	Danbee
Blue	Dunya
Bolero	Eurema
Cha Cha	Marpesia
Lanai	Rock
Lindyhop	Selenia
Maui	Vulcain

2.3.3 Treatments

Temperature/lighting treatments

1. 20°C without supplementary lighting
2. 20°C with 2500 lux supplementary lighting for 12 hours/day.
3. 15°C with 2500 lux supplementary lighting for 12 hours/day.
4. 25°C with 2500 lux supplementary lighting for 12 hours/day.

NB: Supplementary lighting provided by 400W SON/T lamps.

Observational Treatment

Nine cultivars were grown in a separate glasshouse compartment and subjected to DROP treatments to assess if this technique could be used to manipulate plant growth. A 4°C DROP was given for 2 hours immediately after sunrise. The average 24 hour temperature was compensated to ensure a mean temperature of 20°C. No supplementary lighting was used and in all other aspects the crop was grown as per Treatment 1.

Shelf-life treatments

All plants were subjected to a simulated market run prior to shelf-life assessment of 3 weeks. Plants were sleeved and boxed and transported for 3-4 hours before being placed into a simulated shelf-life environment; 20°C day/night temperature, with lighting at 1000 lux for 12 hours/day (0600hrs-1800hrs) provided by cool white fluorescent tubes, and relative humidity of 65% ± 5%.

2.3.4 Experimental Design

Unreplicated trial with the main plots of temperature and lighting in glasshouse compartments in K-Block.

Blocks of each variety within each compartment were in the same geographic location throughout the trial period. Plant layout is shown in Figure 1, Appendix I, page 24.

4	temperature/lighting treatments
x	
16	cultivars
64	plots

Plot size: 36 plants in each varietal block at final spacing of which 24 plants were recorded.

2.3.5 Cultural Details

The rooted cuttings were potted into 12C terracotta pots using Levington C1A growing media. Analysis of growing media at potting is given in Table 1, Appendix II page 25. Plants were placed pot thick into each of the glasshouse compartments and immediately watered in from above using tap water. Subsequently plants were irrigated from below on the ebb and flood floors.

Temperature: plants were grown at temperatures stated in the treatments. All temperatures refer to the mean 24hr glasshouse temperature.

Carbon Dioxide: there was no carbon dioxide enrichment.

Humidity: there was no direct humidity control other than ensuring compartment floors were 'damped down' regularly to maintain a minimum relative humidity of 70% whilst plants remained pot thick in the first 2 weeks after potting.

Irrigation: plants were sub-irrigated using the ebb and flood floors.

Lighting: plants received supplementary lighting as stated in the treatments.

Plant spacing: plants remained pot thick for 2 weeks (69 plants/m^2). At the end of 2 weeks plants were given an intermediate spacing of 40 plants/m^2. Plants were continued to be grown at this spacing until 7 weeks post potting when plants of all cultivars were spaced to 25 plants/m^2.

Pinching: Plants were not pinched.

Shading: Plants were shaded when necessary using a 40% Ludwig Svensson; shading screen set to shade at light levels >450 W/m^2.

Plant growth regulation: No chemical plant growth regulator treatments were applied.

Nutrition: For the first month (commencing 2 weeks after potting), a 4:1:4 NPK feed was applied at an EC of 1.0ms plus background.

Product	Grammes/litre
Potassium Nitrate	35
Calcium Nitrate	20
Ammonium Nitrate	6
Phosphoric Acid (75%)	900 mls

After 1 month, a 2:1:4 NPK feed was applied at an EC of 1.4mS plus background.

Product	Grammes/litre
Potassium Nitrate	35
Calcium Nitrate	6
Phosphoric Acid (75%)	800 mls

Analysis of applied feed (2:1:4) is given in Table 1, Appendix III page 26, along with the analysis results of the water source used at HRI Efford.

Pest and Disease Control

An Integrated Pest Management programme was employed throughout the duration of the trial (see Crop Diary in Appendix IV, page 27 for further details).

2.3.6 Assessments

Growing Media Analyses

A number of growing media analyses were taken throughout the trial from treatments 3 and 4. Media samples were taken from both the top and bottom portions of the pot.

Plant Growth Assessments at Marketing

When 50% of the plants had reached marketing stage (4-5 open flowers), full assessments were made which included:

Plant height	-	measured from the base of the plant to the top of its canopy
Plant diameter	-	measured at its widest width
Number of open flowers	-	total number of open flowers per plant
Number of buds	-	total number of visible buds per plant
Pedicel score	-	qualitative assessment of the flower prominence
Plant quality score	-	qualitative assessment of commercial plant quality
Flower size	-	measurement of open flower diameter

Shelf-life

In shelf-life the following assessments were made on a weekly basis for three weeks:

Number of open flowers

Number of flowers fallen

Number of visible buds

Number of visible buds fallen

Number of leaves fallen

Photographs

Comparison of plant growth treatments were recorded at marketing and at the end of shelf-life.

2.3.7 Statistical Analysis

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

3. RESULTS

3.1 Production Time

At 25°C, production time was reduced by 9.4 days in comparison to plants grown at 15°C, and by 3.2 days and 1.6 days for plants grown at 20°C without or with supplementary lighting respectively. Plant growth was much slower at the cooler temperature of 15°C and hence production time was increased under this treatment. The effect of lighting across cultivars reduced production time by only 1.6 days (Table 1a).

Table 1a Effect of temperature and supplementary lighting on the number of days from potting until marketing

Treatment	20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux
Mean	58.4	56.8	64.6	55.2

There was a strong difference in production time between cultivars. The fastest maturing cultivars were Blue and Eurema*, with an average production time of 5.2 weeks and 5.7 weeks respectively. The Classical type cultivars tended to have a longer production time. Table 1b on page 12 has attempted to classify cultivars from the results in this trial into 'response' groups.

Table 1b: Average production time for each cultivar

Cultivar	Production Time (weeks)				
	5-6 weeks	7-8 weeks	8-9 weeks	9-10 weeks	10-11 weeks
Anaea				✓	
Antigua		✓			
Aruba			✓		
Blue	✓				
Bolero			✓		
Cha Cha				✓	
Danbee					✓
Dunya		✓			
Eurema*	✓			[✓]	
Lanai			✓		
Lindyhop		✓			
Marpesia		✓			
Maui		✓			
Rock					✓
Selenia				✓	
Vulcain				✓	

* Eurema flowered very early and it is assumed that 'premature' flowering caused this response. Upon further observations it appeared that this cultivar can expected to be grown within 9-10 weeks. Table 1 in Appendix V on page 28 shows the complete set of results.

3.2 Assessments at Marketing

Comparison of the effect of treatments on plant growth at marketing are shown as colour plates 1-5 in Appendix VIII on pages 58 to 62.

3.2.1 Plant Height

Across cultivars there appeared to be little difference in final plant height for each of the treatments at marketing (Table 2, Appendix V, page 29). However, upon assessment of each cultivar temperature, and lighting to a lesser extent, had a strong effect on plant height, and the overall appearance and habit of the plant. Plant height was reduced at marketing for the following cultivars; Anaea, Danbee, Eurema and Rock, where plants had been grown at 15°C. In contrast, the cultivars Antigua, Bolero, Dunya, Lanai, Maui and Vulcain were smaller in height when grown at 25°C; the higher temperatures causing plant growth to become stunted and distorted. The cultivars Eurema and Vulcain also lost their variegation at 25°C, whilst variegation was most prominent at 15°C.

3.2.2 Plant Spread

Plants grown at 15°C had a greater mean spread. It was a characteristic for these plants to have much shorter internodes and a broader plant habit. At warmer temperatures, 25°C, plant spread was reduced and plants tended to 'stretch' more at this temperature. Plants grown with supplementary lighting were slightly larger in their spread (Table 2a).

Table 2a Effect of temperature and supplementary lighting on the mean plant spread

Treatment	20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux
Mean (cm)	31.4	33.5	35.2	30.7

There were strong differences between cultivars (Table 3, Appendix V, page 30). The cultivars Anaea, Aruba, Marpesia and Rock had generally a greater mean diameter, whilst the cultivar Blue was much smaller in its habit.

3.2.3 Flower Prominence

There was little difference overall between the treatments, but there were some strong differences between cultivars. A low pedicel score indicates that the flowers tended to be hidden within the foliage, whilst a higher score (>2.0) shows that the flowers were more prominent on a plant. The cultivars Blue, Danbee, Lindyhop and Vulcain all scored highly, whilst the flowers on the cultivars Bolero, Eurema, Rock and Selenia were hidden (Table 4, Appendix V, page 31).

3.2.4 Number of Open Flowers

Although these records were taken at 'marketing' when plants should each have 3-4 open flowers, the records tended to show how floriferous each cultivar was, and the effect of temperature and supplementary lighting.

Plants grown at a higher temperature, 25 °C, had a lower number of open flowers because at this temperature flowers deteriorated more rapidly and did not last as long on the plants. Thus, as an average across the 36 plants in a plot the flowering score was lower at 25 °C due to a greater number of plants with only 2-3 flowers open. Plants were most floriferous at 20 °C with supplementary lighting (Table 5, Appendix V on page 32).

3.2.5 Number of Flower Buds

There were pronounced differences in the number of buds recorded at marketing between each of the treatments (Table 3a).

Table 3a: Number of visible buds recorded

Treatment	20 °C no lights	20 °C 2500 lux	15 °C 2500 lux	25 °C 2500 lux
Mean	37.0	42.7	51.3	19.4

Maximum number of buds were produced at 15 °C, whereas at higher temperatures, 25 °C, bud number was considerably reduced. Supplementary lighting appeared to increase the mean number of buds per plant (Table 6, Appendix V on page 33).

3.2.6 Plant Quality

Temperature and cultivar selection had a large effect on final plant quality. The Paradise series of New Guinea Impatiens were more compact in their habit, floriferous, with prominent flowers and of better final quality.

Table 4a below shows the effect of temperature and supplementary lighting on plant quality.

Table 4a: Effect of temperature and supplementary lighting on final plant quality

Treatment	20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux
Mean	1.2	1.1	1.7	0.9

Maximum score possible is 2.0. Plants grown at 15°C were of better quality. Flower size and colour were improved and plants were less liable to become 'stretched'. Plants grown at 25°C were of very poor quality with the exception of the cultivars Vulcain, Lanai, Dunya and Antigua. Plants grown at higher temperatures tended to be more 'straggly' in their habit. Flower size and colour were reduced, and the flowers rapidly deteriorated and fell. There was little difference in final quality between plants grown at 20°C with or without supplementary lighting (Table 7, Appendix V, page 34).

3.2.7 Flower Size

There was an influence of temperature on flower size (Table 5a).

Table 5a: Effect of temperature and supplementary lighting on flower size

Treatment	20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux
Mean (cm)	5.4	5.4	7.2	4.6

Flower size was reduced at 25°C, whilst the colour and size of flowers was considerably improved at 15°C. Full results are shown in Table 8, Appendix V, page 35.

3.3 Observation on the Effect of DROP on Plant Growth and Flowering

Table 6a below outlines the plant growth assessments recorded at maturity.

Table 6a: Plant growth records at marketing from the observation on DROP

Cultivar	Mean Plant Height (cm)	Mean Plant Diameter (cm)	Mean Pedicel Score (1-3)	Mean Number Open Flowers	Mean Number Buds	Mean Quality Score (0-2)
Anaea	19.1 (24.9)	35.5 (34.2)	2.1 (2.8)	3.5 (7.6)	40.7 (29.0)	1.3 (1.0)
Antigua	14.6 (20.2)	30.7 (29.8)	2.6 (2.3)	2.0 (6.2)	41.6 (50.5)	2.0 (1.3)
Aruba	17.6 (19.2)	39.3 (33.7)	2.1 (1.7)	7.6 (7.5)	63.8 (50.2)	1.9 (1.5)
Blue	6.8 (5.8)	26.4 (20.6)	2.1 (2.4)	2.4 (1.0)	5.1 (5.9)	1.4 (0.0)
Bolero	16.9 (19.3)	32.9 (33.5)	2.3 (1.5)	6.1 (4.6)	43.2 (44.7)	1.9 (0.9)
Dunya	16.8 (18.5)	31.7 (29.1)	2.8 (2.4)	5.7 (4.4)	47.2 (45.7)	1.8 (1.6)
Eurema	15.3 (14.6)	35.3 (30.9)	1.0 (1.2)	1.6 (2.5)	28.4 (6.6)	1.3 (1.7)
Lindyhop	13.6 (15.1)	29.7 (26.7)	2.8 (2.7)	3.3 (4.3)	48.1 (49.5)	2.0 (1.7)
Selenia	17.0 (20.7)	32.0 (31.3)	1.9 (2.0)	3.2 (3.0)	32.7 (18.7)	2.0 (1.5)
Mean	15.3 (17.6)	32.6 (30.0)	2.2 (2.1)	3.9 (4.6)	39.0 (33.4)	1.7 (1.2)

NB: ( ) = mean results from plants grown continuously at 20°C without DROP or supplementary lighting.

Mean plant height was reduced where DROP had been applied, whilst the mean plant spread was increased. There was no difference in flower prominence between treatments. The mean number of open flowers was reduced, whilst the mean number of buds increased, and overall plant quality was better for plants grown under a DROP regime.

3.4 Water Available Compost Analyses

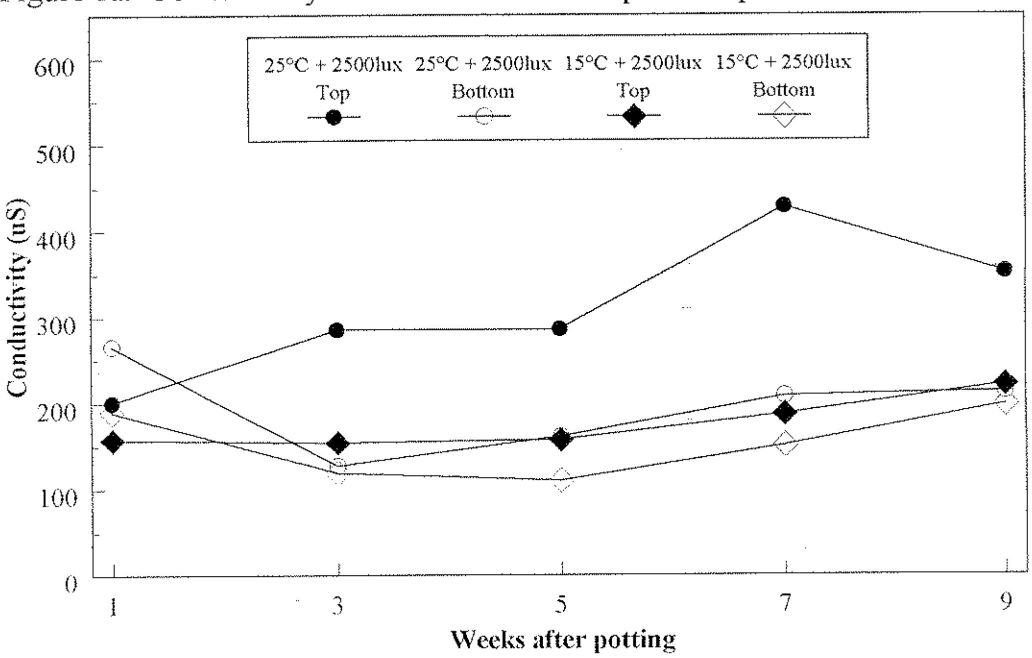
The results from samples taken every two weeks from one week after potting are given in Appendix VI, Tables 1-6, pages 36 to 41.

There were differences not only between plants grown at 15°C and at 25°C, but there were considerable variations in nutrient concentrations between the bottom and top portions of the 10 cm pot.

Plants grown at 25°C received a greater number of irrigations and subsequently the nutrient status of the compost in this growing regime was considerably higher than for plants grown at 15°C.

One week after potting the compost at the bottom of the pot had a higher nutrient status than that at the top. However, over time the levels of nutrient at the top of the pot rose quickly, and dramatically so during the final 7-10 days of production. The nutrient level of the compost in the bottom portion of the pot were consistently lower (Figure 1a).

Figure 1a. Conductivity level results from compost samples



3.5 Shelf-life Assessments

The effect of cultural treatments were assessed in shelf-life and the results are shown graphically in Appendix VII, figures 1-16 on pages 42 to 58.

Temperature had a marked effect on shelf-life and plants grown at 25°C had a poorer shelf-life. Plants grown at 20°C with or without supplementary lighting had a better shelf-life, whilst some cultivars grown at 15°C had an improved shelf-life; Vulcain, Selenia, Lanai, Marpesia and Cha Cha. There were no consistent trends between plants lit and unlit.

The cultivars Anaea, Lanai, Bolero, Rock and Cha Cha appeared to have a better shelf-life, holding their flowers well, with less rapid deterioration in shelf-life. Typically, however, flower and bud drop occurred after 7-10 days for all cultivars. Plants recovered towards the end of the shelf-life assessment but their flowers were smaller in size and their colour appeared much paler.

Plants grown under a DROP regime were not assessed in shelf-life.

4. DISCUSSION

Plant growth and flowering of New Guinea Impatiens is clearly affected by the temperature at which they are grown.

Higher temperatures of 25°C will reduce production time, although there is an effect on plant growth and final quality. There were some differences between cultivars, but generally plant growth produced at 25°C became distorted and stunted, and foliage quality was severely reduced, particularly for the cultivars Aruba, Bolero, Cha Cha and Rock. The cultivars Vulcain and Eurema completely lost their variegation at 25°C. Although plants were quicker to flower at this temperature, flower colour and size were reduced and flowers rapidly shrivelled whilst on the plant. It is not recommended to grow New Guinea Impatiens at such high temperatures in the early part of the year.

Plants which were grown at 15°C took longer to reach marketing stage, but final plant quality was improved. Plant growth and habit suited production in a 10 cm pot. Plant growth did not become as 'stretched' as seen at higher temperatures. Rooting appeared to be more vigorous at this lower temperature, although this may reflect the generally lower nutrient status of the compost at the lower growing temperature. Flower colour and size were improved at 15°C, although plants were not as floriferous as those grown at 20°C, but plants grown at 15°C had considerably more flower buds when recorded at marketing. Only two cultivars, Aruba and Marpesia appeared to suffer in their early stages of growth at this lower temperature.

Plants grown at 20°C were more floriferous. There was little difference between plants grown with or without supplementary lighting. Overall, there were no consistent differences in plant growth, and supplementary lighting hastened flowering and marketing by only 1.6 days across cultivars. The small effect of supplementary lighting may be attributed to the fact that potting was delayed until week 8. It would be envisaged that earlier plantings, grown under poorer natural light, would potentially benefit much more from the use of supplementary lighting.

The Paradise series of New Guinea Impatiens were superior in terms of their habit, plant uniformity and profusion of flowers. Their compact habit was better suited to production in a 10 cm pot, whilst their uniformity at flowering was particularly evident in comparison to the Classical types. A summary of cultivar performance is given in Appendix IX, page 64 where some brief notes describe plant growth in production, and subsequently in shelf-life.

The shelf-life of New Guinea Impatiens is typically poor. Plants often lose their flowers and buds within days of being placed into shelf-life. Plants grown at 25°C had a very poor shelf-life, whilst those grown at 20°C and 15°C were better. There were some differences between plants lit and unlit. Supplementary lighting appeared to increase flowering and the ability to 'maintain' flowering through into shelf-life. However, in some cultivars it appeared that plants unlit had a better shelf-life, as if plants were more 'conditioned' to the lower light levels experienced in shelf-life.

5. CONCLUSIONS

The wide range of cultivars available today can overwhelm growers with choice, but correct varietal choice is important for different markets.

Early season production in a 10 cm pot (or 13 cm) should rely on cultivars from the Paradise series. Their habit suits production at higher densities without the need for chemical plant growth regulators. At 20°C, final spacing of $25m^2$ should be the minimum otherwise height control can be difficult. Lower temperatures produce more compact plants which can be grown nearer to $30/m^2$. DROP (4°C for 2 hours after sunrise) has successfully been shown to manipulate plant growth.

For production throughout the early season months, January-April, supplementary lighting should be considered to increase plant quality and flowering and to reduce production time.

Plants can be produced at temperatures near to 15°C. Dependent upon crop scheduling, production at these lower temperatures would potentially reduce energy costs. Higher temperatures can be used to speed flowering, but plant quality will be reduced the longer higher temperatures are applied.

Lighting can influence post-harvest performance. Further study is needed to see if plants produced early in the season with supplementary lighting require a period of lower light to condition them before sale. Plants grown at lower temperature have increased shelf-life. Therefore, reduction in temperatures in the final weeks of production is recommended.

Key Findings

- Plants should not be grown at very high temperatures c. 25°C.
- Plants grown at cooler temperatures are of better quality with improved flower size and colour.
- Little benefit from the use of supplementary lighting; but further study is needed to evaluate its use in more detail.
- Use of DROP successfully reduced plant height.
- Paradise series of New Guinea Impatiens are better suited to commercial production in 10 cm pots - compact habit and floriferous nature are advantageous.
- The quality of plants in shelf-life and their longevity continue to pose problems with rapid flower and bud drop.

6. FUTURE WORK

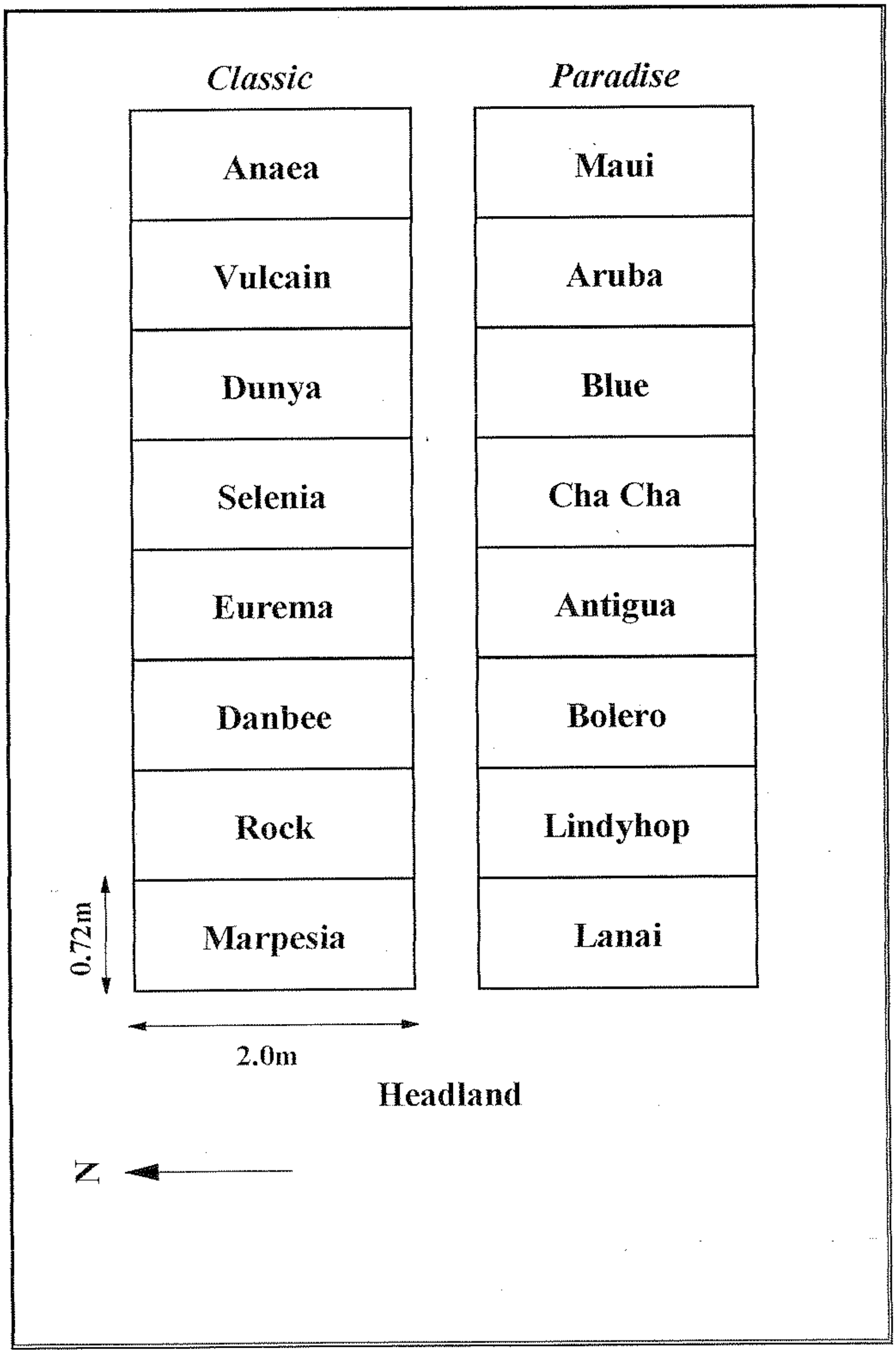
It is clear from these trials that New Guinea Impatiens are very responsive to temperature. It remains unclear what controls floral initiation and development. It appears that cooler temperatures may promote floral initiation in New Guinea Impatiens. These factors and those associated with lighting integral and photoperiod are to be studied in a 3 year MAFF funded programme which will commence in 1996.

The effect of nutrition on the growth and flowering of New Guinea Impatiens is to be examined in the second part of this HDC funded trial during the early summer season. For the results of this trial please refer to HDC Report PC 80a - Part II (1994) Effects of Nutrition.

APPENDICES

APPENDIX I

Figure 1: Layout of Plants in compartment



APPENDIX II

Table 1: Water Available Compost Analysis at potting (C1A)*

Conductivity us/cm	253.0
pH value	4.1
Nitrate-N mg/l	52.2
Ammonium-N mg/l	19.8
Potassium mg/l	132.0
Phosphate-P mg/l	78.6
Magnesium mg/l	40.8
Calcium mg/l	11.4
Sodium mg/l	37.2
Sulphate mg/l	195.6
Manganese mg/l	0.24
Iron mg/l	0.66
Copper mg/l	0.06
Boron mg/l	0.36
Zinc mg/l	0.12
Chloride mg/l	58.8
Density kg/m^3	374.0
Dry matter %	33.3
Dry density	124.5

* Although the initial pH of the growing media was low at potting (magnesium limestone was excluded from mix) there were no apparent detrimental effects on plant growth or quality. Subsequently the growing media pH rose over time.

APPENDIX III

Table 1: Nutrient Solution Analysis

	Applied liquid feed	Tap water
Conductivity us/cm	1670	490
pH value	6.2	7.8
Nitrate-N mg/l	143.0	5.6
Ammonium-N mg/l	0.9	<0.1
Potassium mg/l	360.0	<0.1
Phosphate-P mg/l	104.0	0.1
Magnesium mg/l	2.9	2.3
Calcium mg/l	125.0	100.0
Sodium mg/l	15.2	12.0
Sulphate mg/l	24.0	21.0
Manganese mg/l	0.01	<0.01
Iron mg/l	0.03	0.02
Copper mg/l	<0.01	<0.01
Boron mg/l	0.08	0.04
Zinc mg/l	0.27	<0.01
Chloride mg/l	31.0	22.0

APPENDIX IV

Crop Diary

Date	Operation
24 February	Plants were potted and commenced treatments.
10 March	Intermediate spacing at 40 plants/m^2.
11 March	Commence application of liquid feed 4:1:4 NPK applied at an EC of 1.0 (plus background) at every watering.
15 March	Applied Iprodione as Rovral at 0.5 g/l for prevention of *botrytis*.
11 April	Commence new liquid feed: 2:1:4 NPK applied at an EC of 1.4ms (plus background) at every watering.
14 April	Final spacing at 25 plants/m^2.

Biocontrol agents introduced:

On a weekly basis

Aphidius matricariae
Aphidoletes aphidomyza
Encarsia formosa
Phytoseiulus persimillis

Every four weeks

Amblyseius cucumeris
Digiyphus aibirica

APPENDIX V

Efford: **Results at Marketing**

Table 1: **Marketing Dates - Number of days from potting until 50% flowering**

Cultivar	20°C no lights	Cultural Treatments 20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	61	60	78	68	66.7
Antigua	58	54	61	48	55.2
Aruba	63	63	67	54	61.7
Blue	35	34	46	32	36.7
Bolero	61	58	67	56	60.5
Cha Cha	67	66	69	66	67.0
Danbee	70	67	71	76	71.0
Dunya	53	52	57	45	51.7
Eurema	34	34	67	27	40.5
Lanai	62	63	67	56	62.0
Lindyhop	56	54	57	50	54.2
Marpesia	58	55	57	49	54.7
Maui	54	49	57	45	51.2
Rock	72	69	77	66	71.0
Selenia	64	63	67	76	67.5
Vulcain	66	68	69	70	68.2
Mean	58.4	56.8	64.6	55.2	

APPENDIX V

Efford: **Results at Marketing**

Table 2: **Mean Plant Height (cm)**

Cultivar	Cultural Treatments 20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	24.9	31.0	21.1	27.3	26.0
Antigua	20.2	16.3	19.7	14.9	17.8
Aruba	19.2	19.9	22.1	18.1	19.8
Blue	5.8	6.3	5.7	6.0	5.9
Bolero	19.3	21.3	24.2	17.4	20.5
Cha Cha	15.3	15.4	19.7	14.5	16.2
Danbee	27.0	27.0	23.5	25.2	25.7
Dunya	18.5	15.5	20.2	13.6	16.9
Eurema	14.6	19.0	10.8	14.5	14.7
Lanai	16.7	18.4	20.1	14.8	17.5
Lindyhop	15.1	16.0	17.9	15.7	16.2
Marpesia	21.6	23.3	26.6	25.1	24.1
Maui	15.0	13.4	16.1	10.2	13.7
Rock	36.5	33.3	25.8	29.9	31.4
Selenia	20.7	23.6	21.6	30.1	24.0
Vulcain	26.3	25.8	30.9	21.0	26.0
Mean	19.8	20.3	20.4	18.6	

APPENDIX V

Efford: **Results at Marketing**

Table 3: **Mean Plant Spread (cm)**

Cultivar	Cultural Treatments 20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	34.2	40.7	36.5	41.0	38.1
Antigua	29.8	31.0	33.6	31.1	31.4
Aruba	33.7	33.4	41.5	36.5	36.3
Blue	20.6	22.0	24.5	17.5	21.1
Bolero	33.5	34.1	40.9	31.3	34.9
Cha Cha	29.5	32.2	37.0	28.9	31.9
Danbee	29.3	30.6	34.5	26.6	30.2
Dunya	29.1	40.4	33.8	22.8	31.5
Eurema	30.9	35.1	28.6	28.3	30.7
Lanai	30.0	34.5	37.7	30.6	33.2
Lindyhop	26.7	29.5	32.0	29.6	29.4
Marpesia	36.9	36.5	38.9	36.5	37.2
Maui	31.0	29.4	32.0	23.0	28.8
Rock	42.7	40.8	35.5	39.3	39.6
Selenia	31.3	34.5	34.8	36.2	34.2
Vulcain	32.9	32.0	41.3	31.6	34.4
Mean	31.4	33.5	35.2	30.7	

APPENDIX V

Efford: **Results at Marketing**

Table 4: **Mean Pedicel Score (1 = flowers held within foliage, 3 = flowers prominent)**

	Cultural treatments				
Cultivar	**20°C no lights**	**20°C 2500 lux**	**15°C 2500 lux**	**25°C 2500 lux**	**Mean**
Anaea	2.8	2.1	2.1	1.9	2.2
Antigua	2.3	2.8	2.6	2.4	2.5
Aruba	1.7	1.8	2.0	1.7	1.8
Blue	2.4	3.0	2.7	2.0	2.5
Bolero	1.5	1.7	1.7	1.3	1.5
Cha Cha	2.0	1.9	2.1	1.4	1.8
Danbee	2.4	3.0	2.4	2.1	2.5
Dunya	2.4	1.9	2.3	2.2	2.2
Eurema	1.2	1.0	1.7	1.0	1.2
Lanai	2.1	1.9	1.7	1.7	1.8
Lindyhop	2.7	2.6	2.6	2.1	2.5
Marpesia	1.3	1.9	2.2	1.8	1.8
Maui	2.5	2.0	2.0	1.9	2.1
Rock	1.0	1.1	1.0	1.0	1.3
Selenia	2.0	1.2	1.6	1.3	1.5
Vulcain	2.8	2.9	2.6	2.5	2.7
Mean	2.1	1.9	2.1	1.8	

APPENDIX V

Efford: **Results at Marketing**

Table 5: **Mean Number of Open Flowers per Plant**

Cultivar	Cultural Treatments 20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	7.6	12.2	3.6	5.4	7.2
Antigua	6.2	2.8	2.6	2.9	3.6
Aruba	7.5	9.7	5.8	2.8	6.4
Blue	1.0	1.2	1.1	0.9	1.0
Bolero	4.6	9.2	7.0	1.7	5.6
Cha Cha	10.2	19.6	7.2	4.6	10.4
Danbee	3.5	6.3	4.8	1.2	3.9
Dunya	4.4	2.2	0.9	0.7	1.6
Eurema	2.5	2.2	0.9	0.7	1.6
Lanai	3.8	6.8	6.8	2.6	5.0
Lindyhop	4.3	7.2	4.4	5.8	5.4
Marpesia	1.7	2.0	4.3	3.7	2.9
Maui	2.5	2.7	3.3	0.7	2.3
Rock	9.6	10.7	2.2	3.0	6.4
Selenia	3.0	5.5	6.2	2.5	4.0
Vulcain	7.2	3.7	8.5	2.2	5.4
Mean	5.0	6.5	4.7	2.7	

APPENDIX V

Efford: **Results at Marketing**

Table 6: **Mean Number of Flower Buds per Plant**

Cultivar	Cultural Treatments 20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	29.0	35.7	53.3	12.9	32.7
Antigua	50.5	52.9	53.9	24.9	45.5
Aruba	50.2	56.7	77.8	23.7	52.1
Blue	5.9	7.0	6.1	5.7	6.2
Bolero	44.7	44.4	50.8	30.8	42.7
Cha Cha	67.7	61.4	66.4	45.8	60.3
Danbee	40.9	37.1	73.7	24.1	43.9
Dunya	45.7	47.4	53.2	11.8	39.5
Eurema	6.6	10.7	4.4	2.2	6.0
Lanai	47.4	50.9	61.8	10.5	42.6
Lindyhop	49.5	62.5	53.3	42.5	51.9
Marpesia	20.2	64.0	39.9	10.2	33.6
Maui	33.9	28.0	57.2	5.5	31.1
Rock	40.8	47.5	58.2	8.1	38.6
Selenia	18.7	37.9	41.6	34.0	33.0
Vulcain	40.2	38.8	69.2	17.1	41.3
Mean	37.0	42.7	51.3	19.4	

APPENDIX V

Efford: Results at Marketing

Table 7: Mean Plant Quality Score (0 = unmarketable, 2 = Grade 1)

Cultivar	20°C no lights	20°C 2500 lux	Cultural Treatments 15°C 2500 lux	25°C 2500 lux	Mean
Anaea	1.0	0.2	1.9	0.3	0.8
Antigua	1.3	1.8	2.0	1.7	1.7
Aruba	1.5	1.2	1.8	1.6	1.5
Blue	0*	1.0	1.4	0*	0.6
Bolero	0.9	0.6	1.2	0.3	0.7
Cha Cha	2.0	1.9	1.8	0.9	1.6
Danbee	0.7	0.2	1.6	0.7	0.8
Dunya	1.6	1.9	1.9	1.8	1.8
Eurema	1.7	1.5	1.7	0.9	1.4
Lanai	1.9	1.7	1.8	1.7	1.8
Lindyhop	1.7	1.7	1.7	1.6	1.7
Marpesia	0.7	0.7	1.9	0.5	0.9
Maui	1.7	1.7	1.9	1.2	1.6
Rock	0**	0**	1.7	0.2	0.5
Selenia	1.5	0.8	1.6	0.3	1.0
Vulcain	1.6	0.9	1.0	1.8	1.3
Mean	1.2	1.1	1.7	0.9	

NB: 0* = unmarketable plant because it was too small
0** = unmarketable plant due to poor quality foliage and 'stretching'

APPENDIX V

Efford: Results at Marketing

Table 8: Mean Flower Diameter

Cultivar	Cultural Treatments 20°C no lights	20°C 2500 lux	15°C 2500 lux	25°C 2500 lux	Mean
Anaea	6.0	5.5	6.0	5.0	5.6
Antigua	7.0	6.0	7.0	6.0	6.5
Aruba	5.5	5.5	7.5	5.0	5.9
Blue	5.5	6.0	7.0	5.0	5.9
Bolero	4.5	5.0	7.0	4.0	5.1
Cha Cha	4.5	4.5	6.0	4.0	4.7
Danbee	5.0	5.5	7.0	4.0	5.4
Dunya	5.5	5.0	6.5	4.5	5.4
Eurema	5.0	5.5	7.0	5.0	5.6
Lanai	5.0	5.0	6.0	5.0	5.2
Lindyhop	6.0	5.5	6.5	4.5	5.6
Marpesia	6.0	6.0	7.5	4.0	5.9
Maui	5.5	6.0	8.0	5.0	6.1
Rock	5.0	6.0	8.0	4.0	5.7
Selenia	5.5	5.0	5.5	4.5	5.1
Vulcain	4.5	5.0	5.5	4.0	4.7
Mean	5.4	5.4	7.2	4.6	

APPENDIX VI

Table 1: Water Available Peat Compost Analysis - 1 week after potting

Treatment area of pot	25°C + 2500 lux top	 bottom	15°C + 2500 lux top	 bottom
Conductivity us/cm	200	266	157	189
pH value	4.4	4.3	4.4	4.2
Nitrate-N mg/l	24.0	46.8	16.2	27.0
Ammonium-N mg/l	6.0	12.0	9.6	12.0
Potassium mg/l	108.0	150.0	84.0	102.0
Phosphate-P mg/l	61.8	85.2	51.6	58.8
Magnesium mg/l	40.8	64.8	30.0	34.8
Calcium mg/l	19.8	28.8	15.0	17.4
Sodium mg/l	38.4	39.0	33.0	38.4
Sulphate mg/l	178.8	204.6	150.0	160.2
Manganese mg/l	0.24	0.36	0.18	0.24
Iron mg/l	0.72	1.32	0.72	1.08
Copper mg/l	0.06	0.06	0.06	0.06
Boron mg/l	0.30	0.36	0.36	0.42
Zinc mg/l	0.06	0.18	0.06	0.18
Chloride mg/l	41.4	55.2	49.8	51.6
Density kg/m^3	466.0	468.0	450.0	461.0
Dry matter %	26.1	30.8	26.2	23.2
Dry density	121.6	144.1	118.4	107.0

APPENDIX VI

Table 2: Water Available Peat Compost Analysis - 3 weeks after potting

Treatment area of pot	25°C + 2500 lux top	25°C + 2500 lux bottom	15°C + 2500 lux top	15°C + 2500 lux bottom
Conductivity us/cm	285	127	154	119
pH value	4.3	4.4	4.3	4.5
Nitrate-N mg/l	66.6	54.6	22.2	46.2
Ammonium-N mg/l	5.4	7.2	3.6	5.4
Potassium mg/l	108.0	84.0	72.0	66.0
Phosphate-P mg/l	81.0	16.2	47.4	15.6
Magnesium mg/l	68.4	11.4	28.8	11.4
Calcium mg/l	66.0	19.8	31.2	20.4
Sodium mg/l	66.6	28.2	48.6	29.4
Sulphate mg/l	276.0	38.4	158.4	45.0
Manganese mg/l	0.30	0.06	0.18	0.12
Iron mg/l	0.84	0.84	0.96	0.96
Copper mg/l	0.06	0.06	0.06	0.06
Boron mg/l	0.24	0.12	0.24	0.12
Zinc mg/l	0.12	0.06	0.18	0.12
Chloride mg/l	77.4	46.2	46.8	37.8
Density kg/m^3	489.0	507.0	586.0	654.0
Dry matter %	22.5	21.9	18.5	17.0
Dry density	110.0	111.0	108.4	111.2

APPENDIX VI

Table 3: Water Available Peat Compost Analysis - 5 weeks after potting

Treatment area of pot	25°C + 2500 lux top	25°C + 2500 lux bottom	15°C + 2500 lux top	15°C + 2500 lux bottom
Conductivity us/cm	286	161	157	110
pH value	4.3	4.8	4.5	4.7
Nitrate-N mg/l	83.4	49.2	18.0	21.6
Ammonium-N mg/l	7.2	4.8	3.0	3.0
Potassium mg/l	132.0	102.0	84.0	84.0
Phosphate-P mg/l	65.4	28.2	50.4	22.2
Magnesium mg/l	57.6	13.8	26.4	9.6
Calcium mg/l	67.8	52.2	31.8	22.2
Sodium mg/l	85.8	39.0	61.2	34.2
Sulphate mg/l	160.2	66.6	146.4	61.2
Manganese mg/l	0.12	<0.06	0.06	<0.06
Iron mg/l	0.84	0.66	0.96	0.72
Copper mg/l	<0.06	<0.06	<0.06	<0.06
Boron mg/l	0.12	<0.06	0.06	<0.06
Zinc mg/l	0.06	<0.06	<0.06	<0.06
Chloride mg/l	87.0	48.6	48.6	40.8
Density kg/m^3	522.0	548.0	557.0	595.0
Dry matter %	22.4	20.3	24.9	19.5
Dry density	116.9	111.2	138.7	116.0

APPENDIX VI

Table 4: Water Available Peat Compost Analysis - 7 weeks after potting

Treatment area of pot	25°C + 2500 lux top	25°C + 2500 lux bottom	15°C + 2500 lux top	15°C + 2500 lux bottom
Conductivity us/cm	428	208	187	151
pH value	4.3	4.9	4.6	5.0
Nitrate-N mg/l	158.4	70.8	36.0	49.8
Ammonium-N mg/l	8.2	4.8	4.3	3.3
Potassium mg/l	174.0	168.0	84.0	120.0
Phosphate-P mg/l	111.6	60.0	56.4	40.2
Magnesium mg/l	76.2	9.0	25.2	6.6
Calcium mg/l	111.0	50.4	30.6	24.6
Sodium mg/l	129.0	40.8	81.6	39.0
Sulphate mg/l	163.2	52.8	163.2	64.2
Manganese mg/l	0.18	<0.06	0.12	0.06
Iron mg/l	0.48	0.24	0.66	0.30
Copper mg/l	<0.06	<0.06	0.06	<0.06
Boron mg/l	0.06	<0.06	0.12	0.06
Zinc mg/l	0.12	0.06	0.06	0.06
Chloride mg/l	120.0	56.4	52.8	47.4
Density kg/m^3	433.0	447.0	474.0	519.0
Dry matter %	26.5	25.3	22.1	20.4
Dry density	114.7	113.1	104.8	105.9

APPENDIX VI

Table 5: Water Available Peat Compost Analysis - 9 weeks after potting

Treatment area of pot	25°C + 2500 lux top	25°C + 2500 lux bottom	15°C + 2500 lux top	15°C + 2500 lux bottom
Conductivity us/cm	352	213	221	198
pH value	4.7	5.6	4.8	5.7
Nitrate-N mg/l	120.6	63.0	39.0	60.0
Ammonium-N mg/l	37.2	54.6	54.0	59.4
Potassium mg/l	288.0	240.0	156.0	270.0
Phosphate-P mg/l	147.6	80.4	122.4	81.0
Magnesium mg/l	26.4	4.2	19.8	3.0
Calcium mg/l	62.4	41.4	25.8	13.8
Sodium mg/l	142.8	44.4	125.4	36.0
Sulphate mg/l	118.8	92.4	171.0	46.2
Manganese mg/l	<0.06	<0.06	0.06	<0.06
Iron mg/l	0.42	0.36	0.66	0.36
Copper mg/l	<0.06	<0.06	0.06	<0.06
Boron mg/l	0.12	0.06	0.12	<0.06
Zinc mg/l	<0.06	<0.06	<0.06	<0.06
Chloride mg/l	100.2	69.0	55.2	62.4
Density kg/m^3	549.0	611.0	571.0	667.0
Dry matter %	19.4	16.9	18.1	16.6
Dry density	106.5	103.3	103.4	110.7

APPENDIX VI

Table 6: Water Available Peat Compost Analysis - 11 weeks after potting

Treatment	25°C + 2500 lux		15°C +_2500 lux	
area of pot	top	bottom	top	bottom
Conductivity us/cm	1105	560	288	187
pH value	4.5	5.3	4.9	5.9
Nitrate-N mg/l	507.6	280.8	54.6	47.4
Ammnium-N mg/l	10.2	7.2	21.0	1.8
Potassium mg/l	894.0	522.0	252.0	246.0
Phosphate-P mg/l	258.6	120.0	182.4	48.0
Magnesium mg/l	130.8	24.6	24.6	1.8
Calcium mg/l	331.8	169.2	36.6	12.0
Sodium mg/l	285.0	118.2	160.8	46.2
Sulphate mg/l	320.4	159.6	189.6	97.8
Manganese mg/l	0.36	0.06	0.12	<0.06
Iron mg/l	0.96	0.60	1.32	0.54
Copper mg/l	0.06	0.06	0.06	0.06
Boron mg/l	<0.06	<0.06	<0.06	<0.06
Zinc mg/l	0.30	0.12	0.06	0.06
Chloride mg/l	262.2	111.0	76.2	38.4
Density kg/m^3	550.0	524.0	538.0	566.0
Dry matter %	22.2	20.4	19.8	17.3
Dry density	122.1	106.9	106.5	97.9

APPENDIX VII

Shelf-life Results

The following pages, 43 to 58, present the results of the shelf-life assessments for each cultivar. Each page consists of four separate graphs which relate to each of the treatments. Within each graph there are records of the mean of:

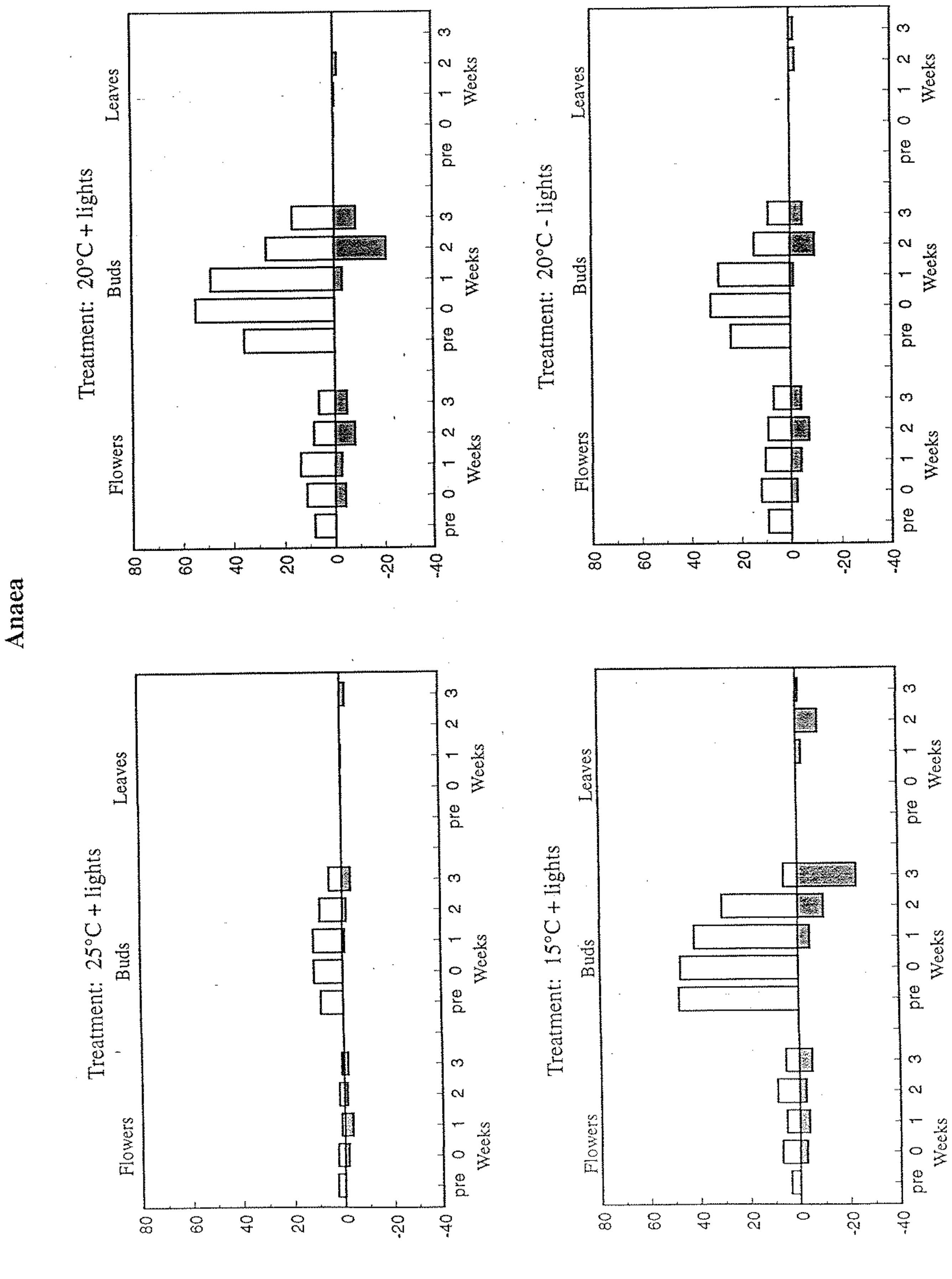
- number of open flowers
- number of visible buds
- number of flowers dropped*
- number of buds dropped*
- number of leaves dropped*

* These results are shown as a negative result and are shown as shaded bars on the graph.

Shelf-life records were taken over a 3 week period. In addition records were taken immediately prior to the start of shelf-life, and when plants were unsleeved, 5 days after entering shelf-life.

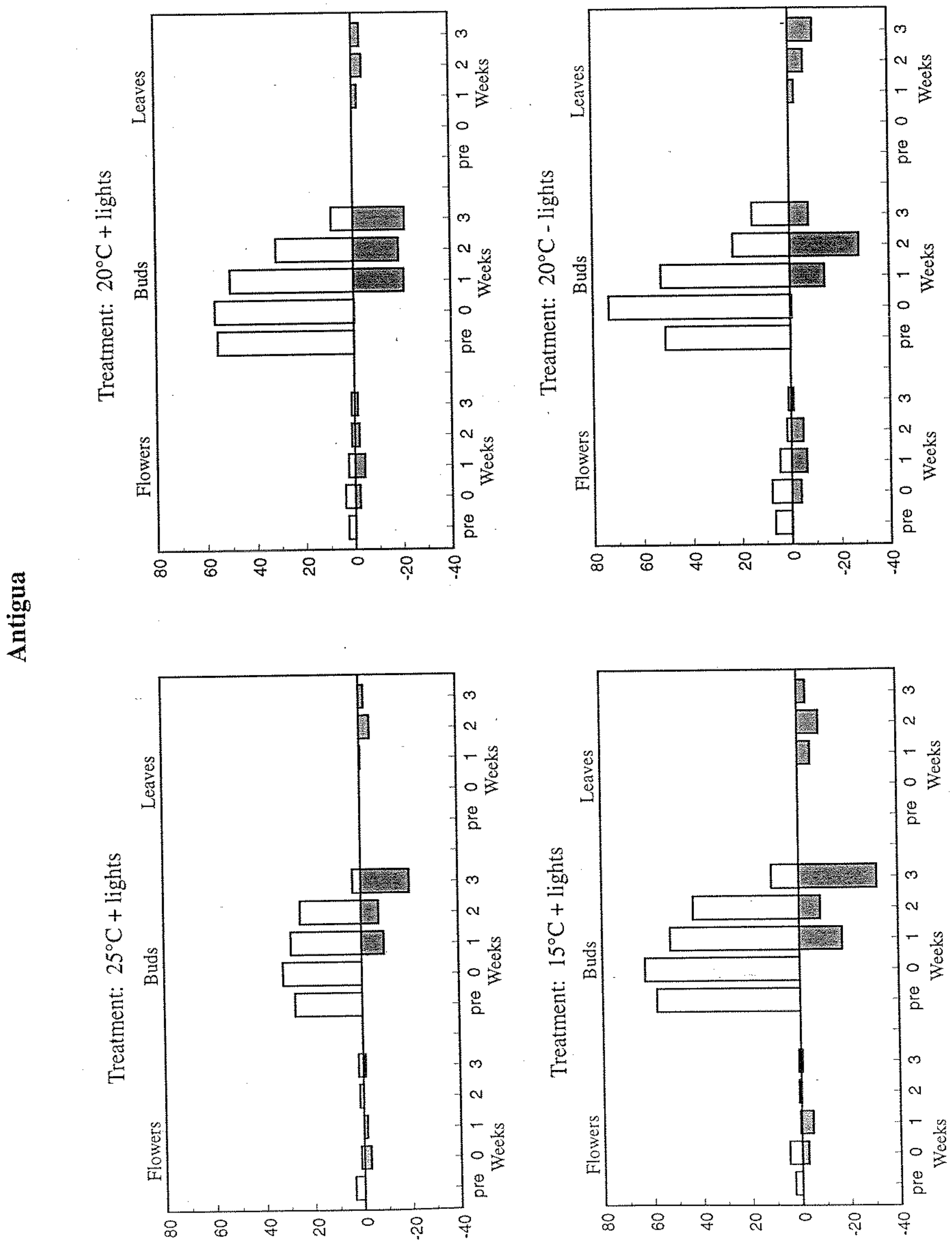
APPENDIX VII

Figure 1



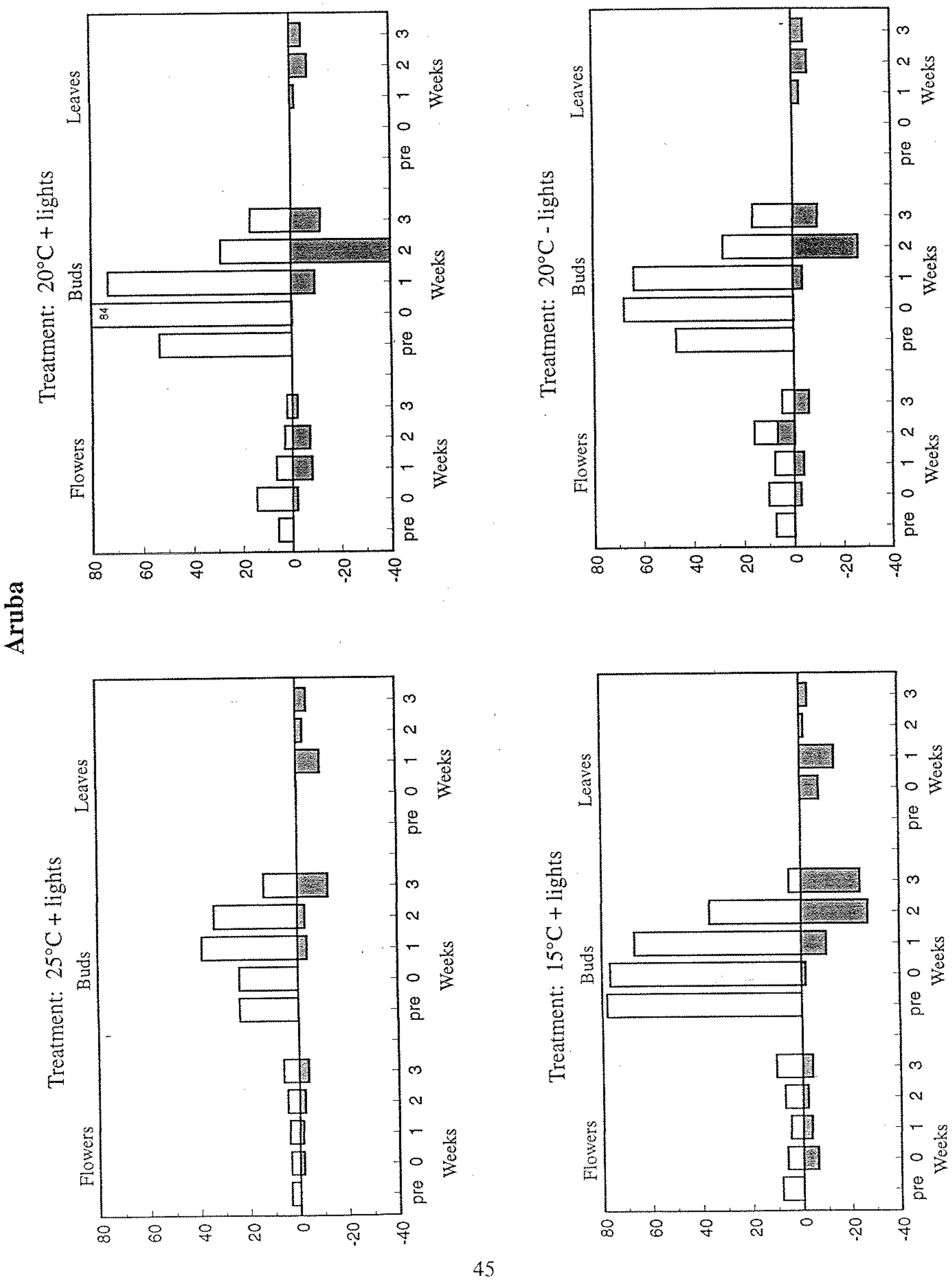
APPENDIX VII

Figure 2



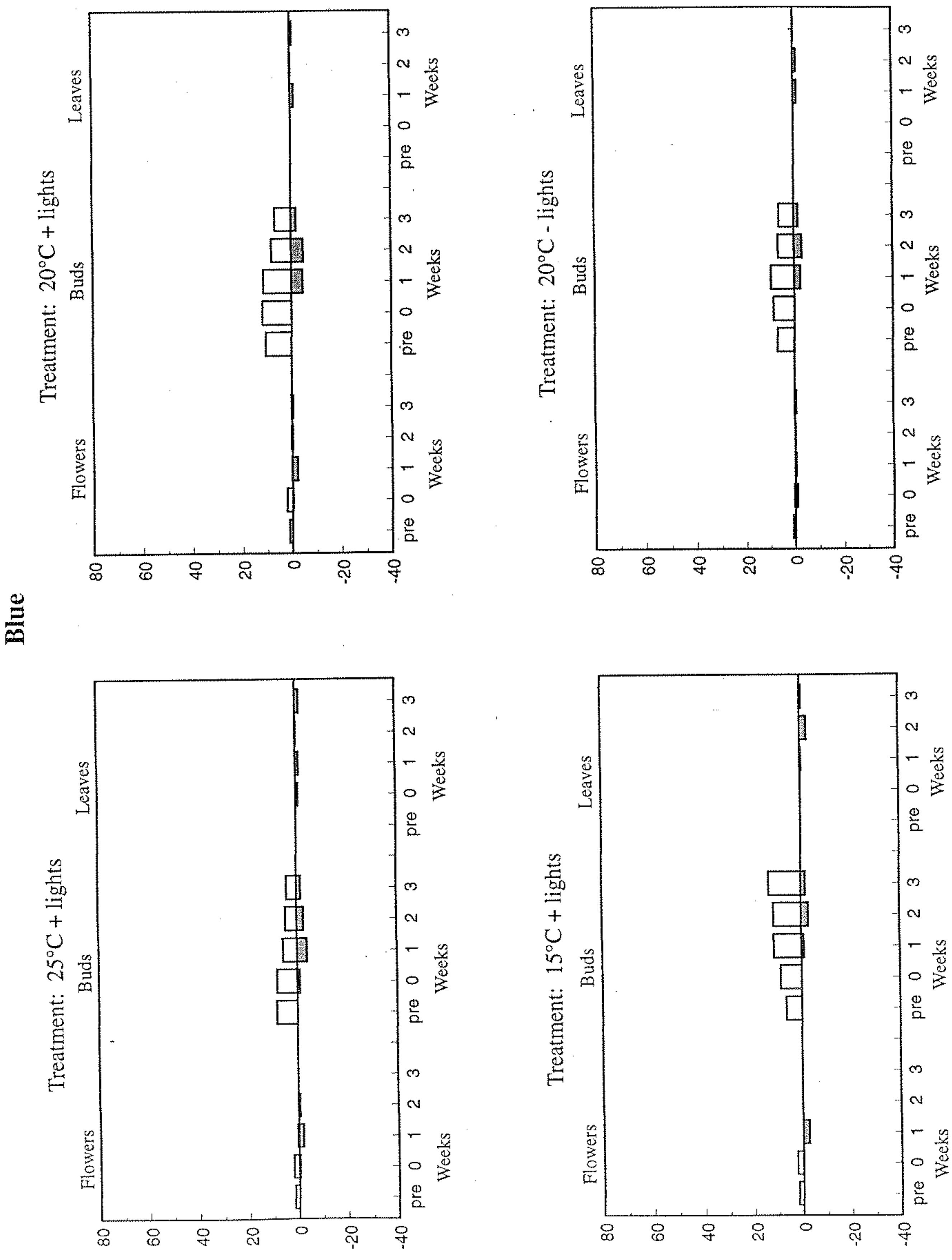
APPENDIX VII

Figure 3



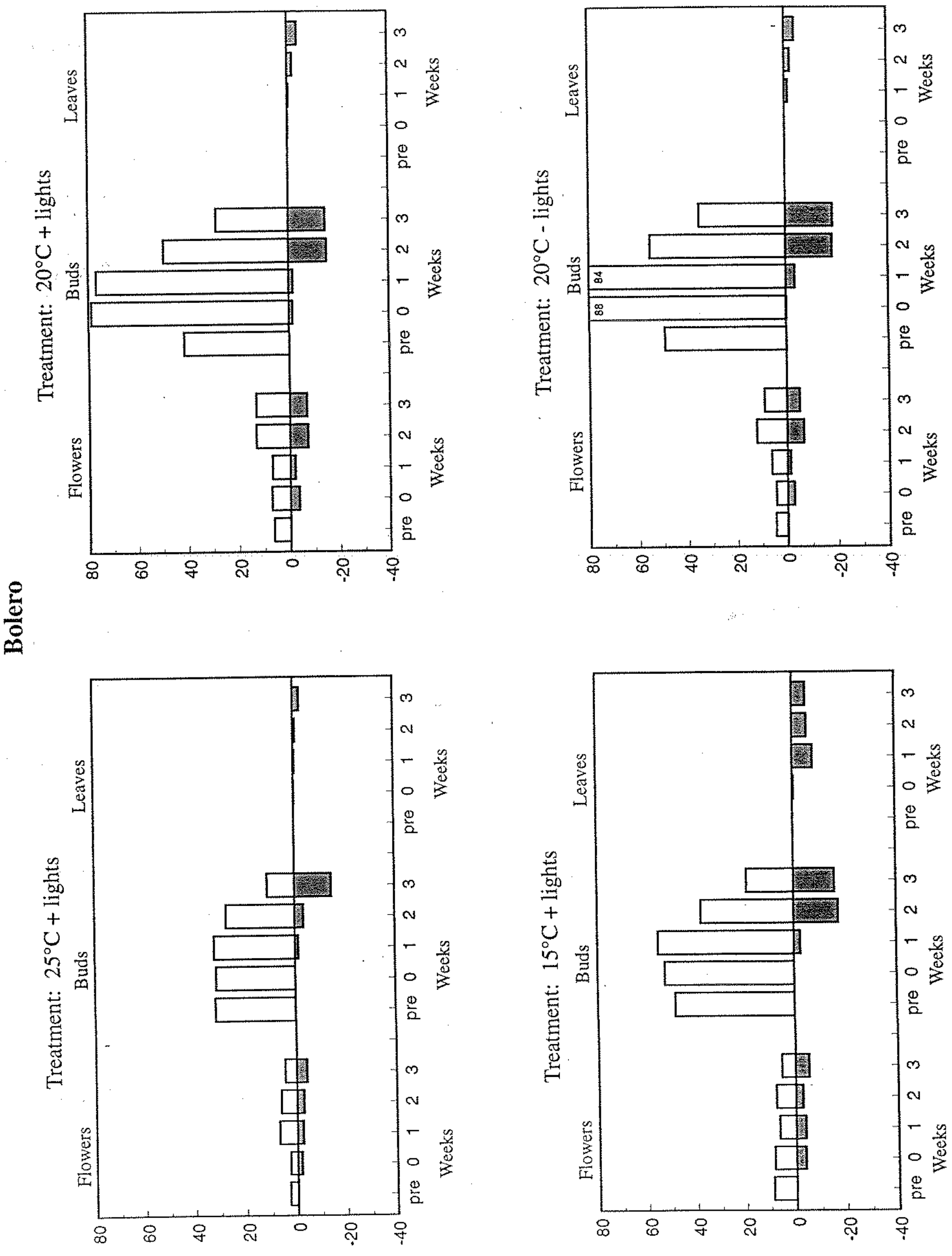
APPENDIX VII

Figure 4



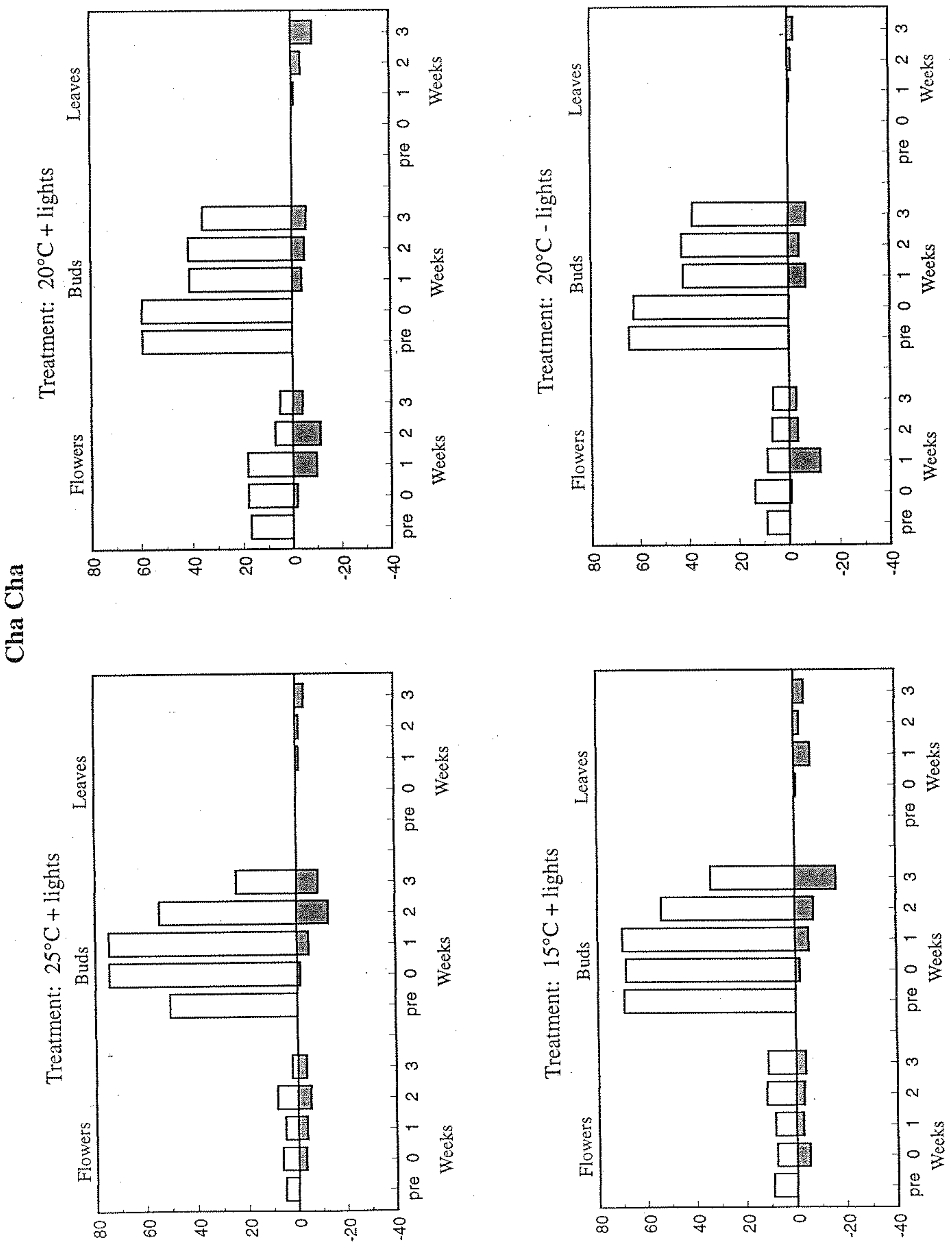
APPENDIX VII

Figure 5



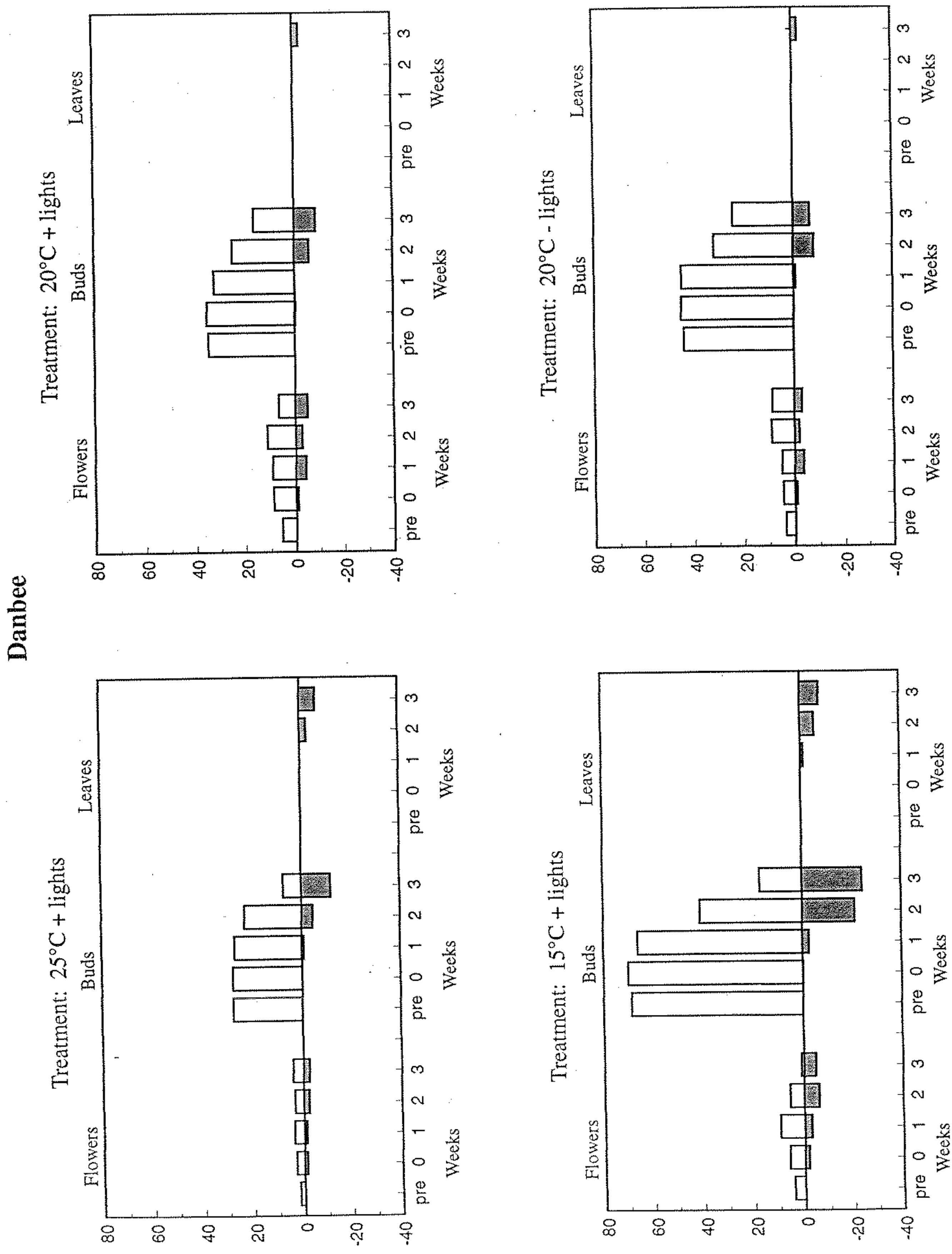
APPENDIX VII

Figure 6



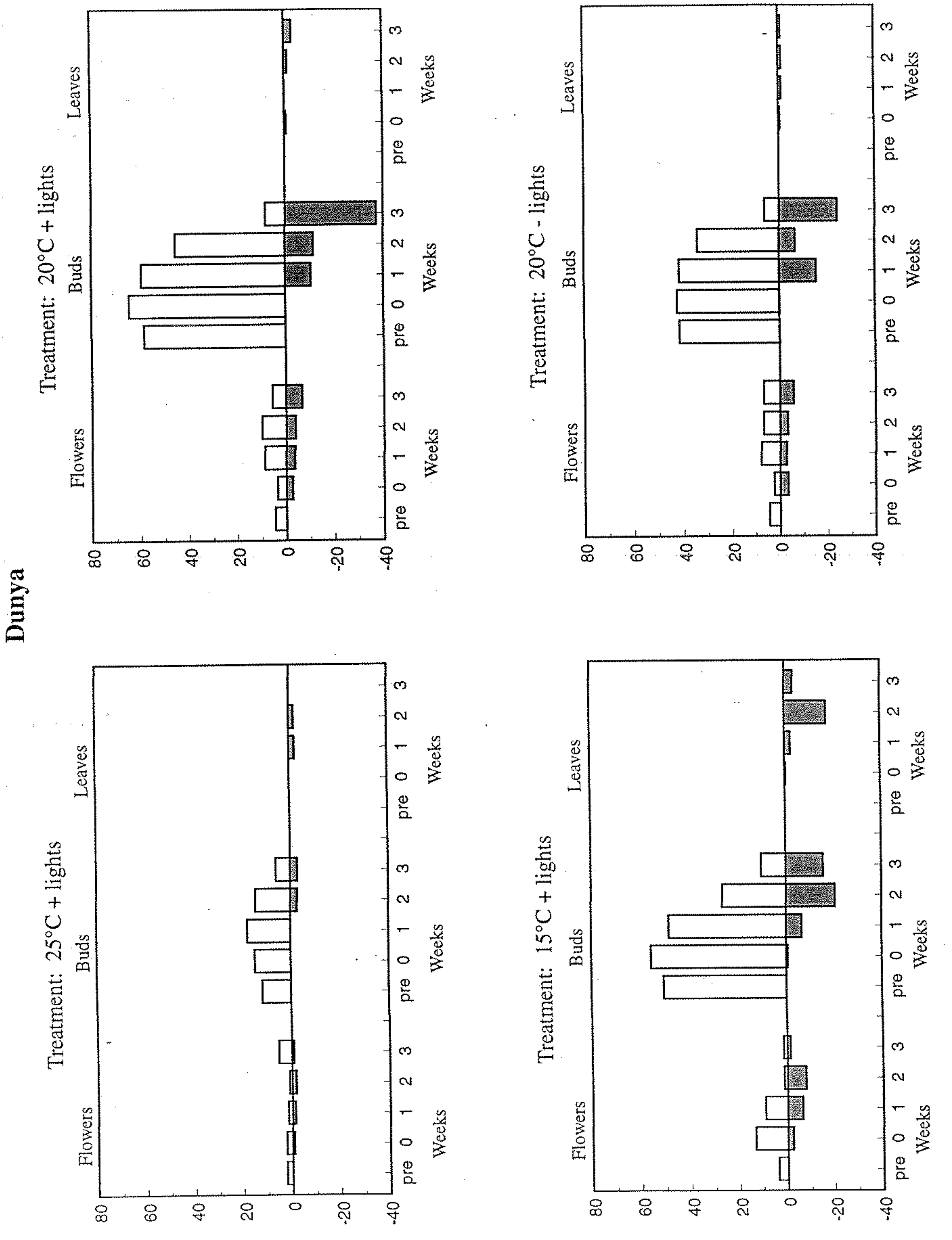
APPENDIX VII

Figure 7



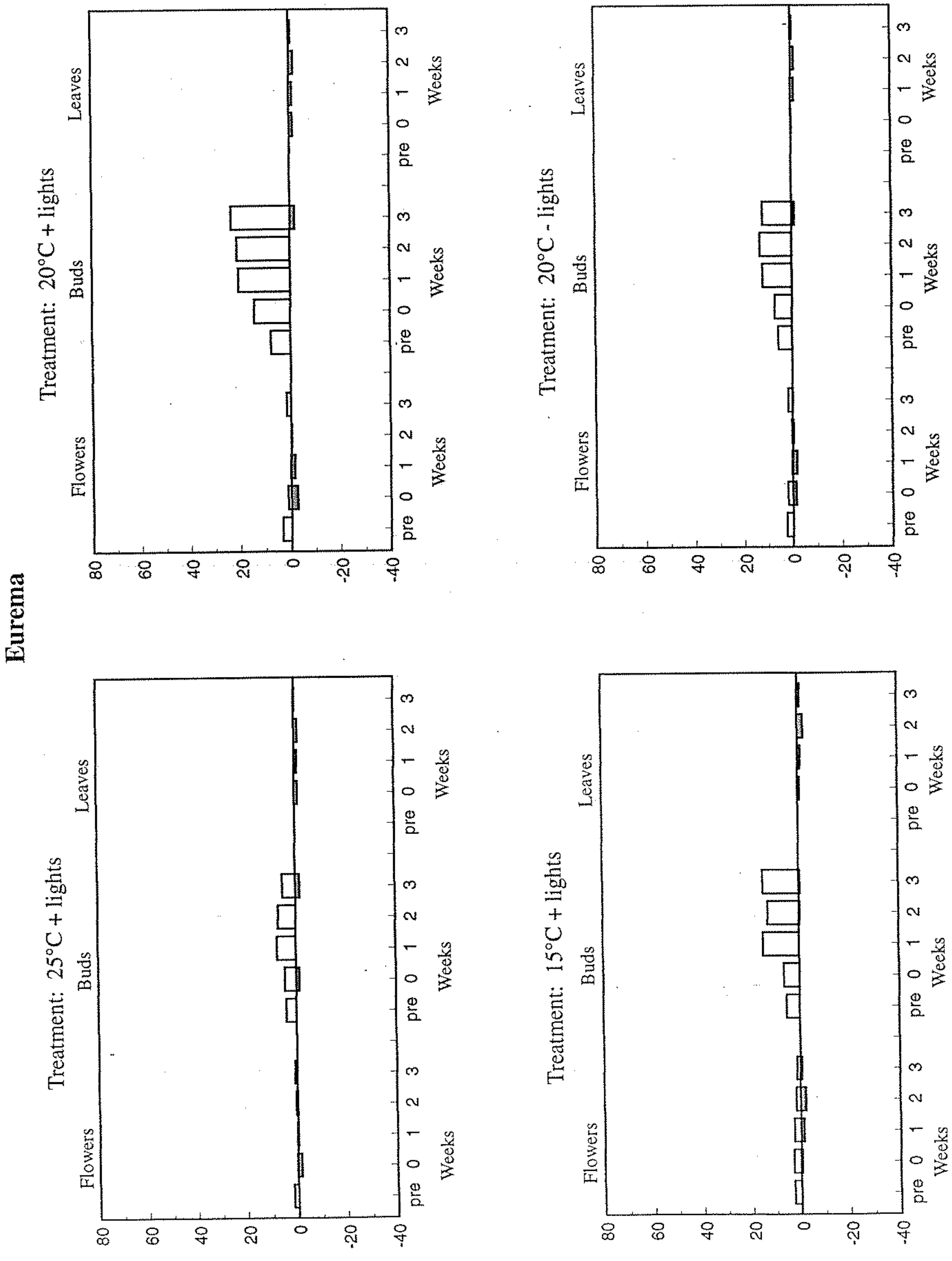
APPENDIX VII

Figure 8



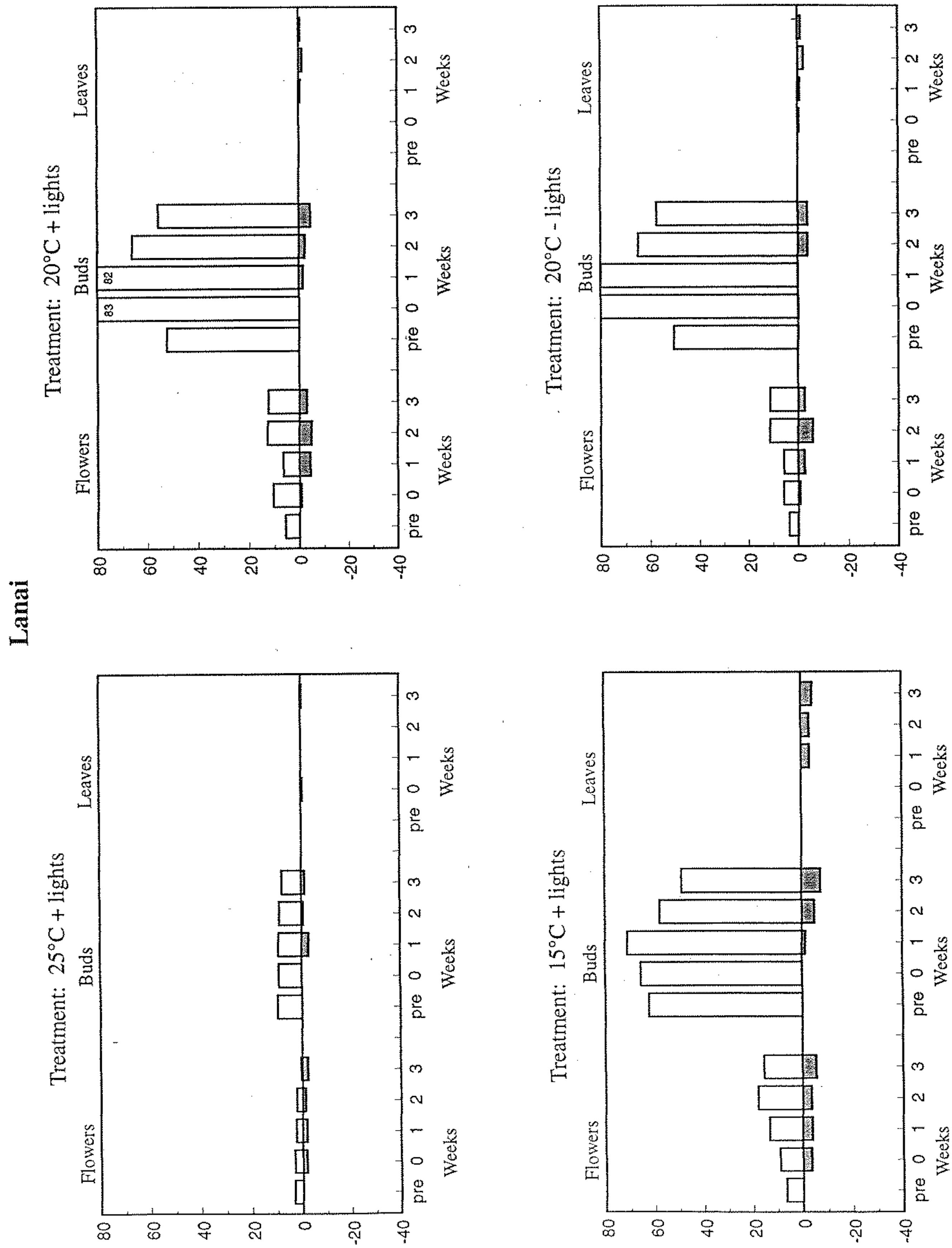
APPENDIX VII

Figure 9



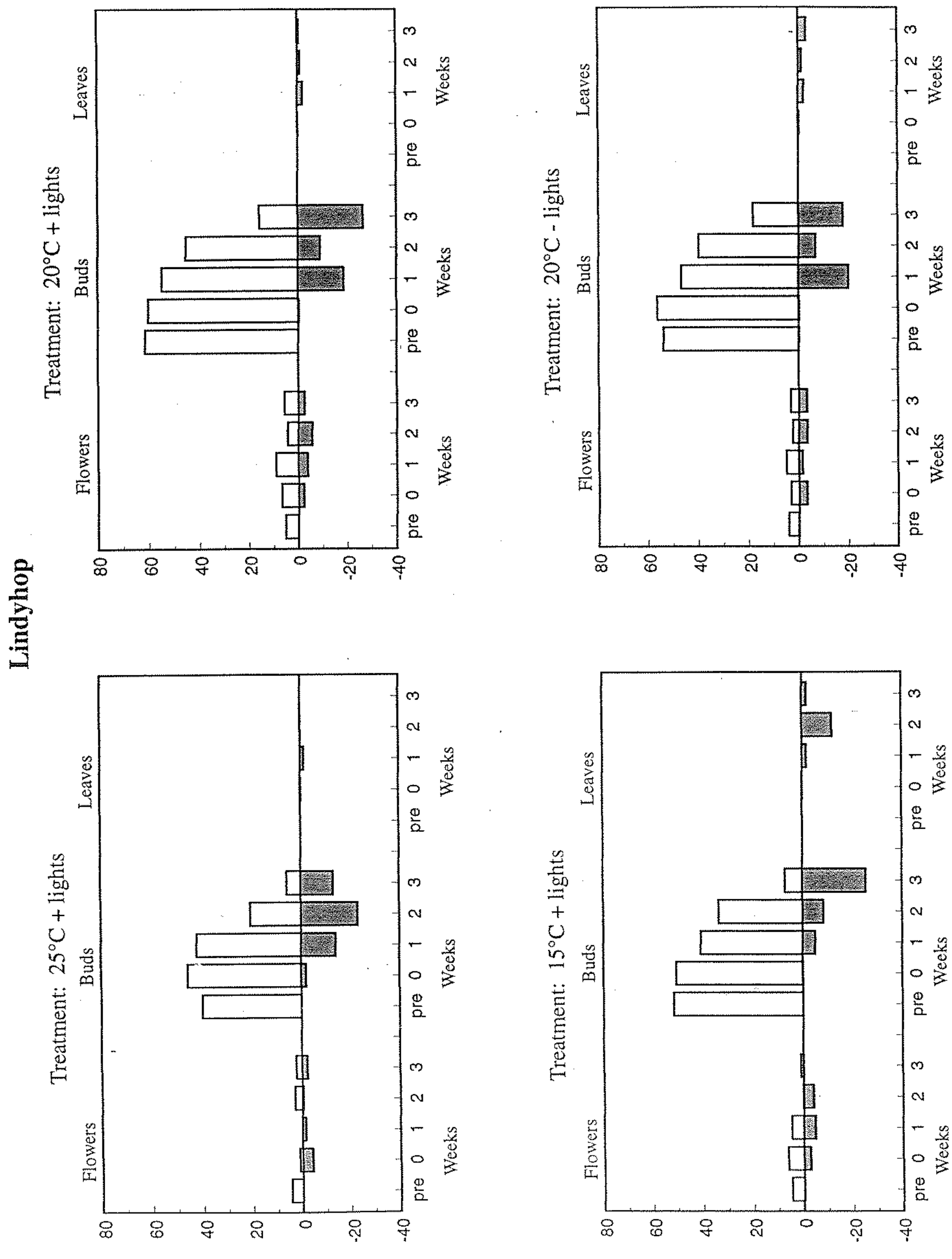
APPENDIX VII

Figure 10



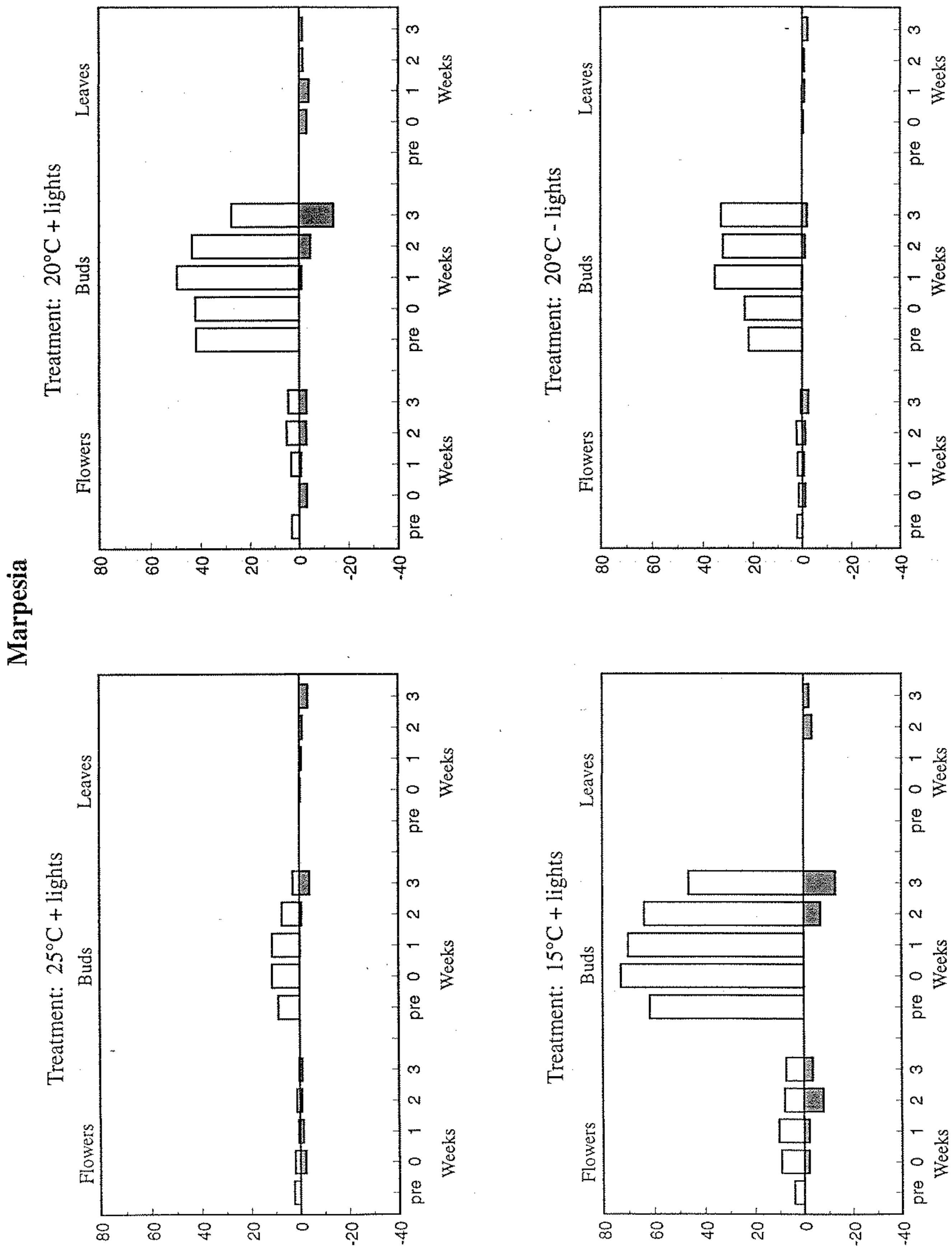
APPENDIX VII

Figure 11



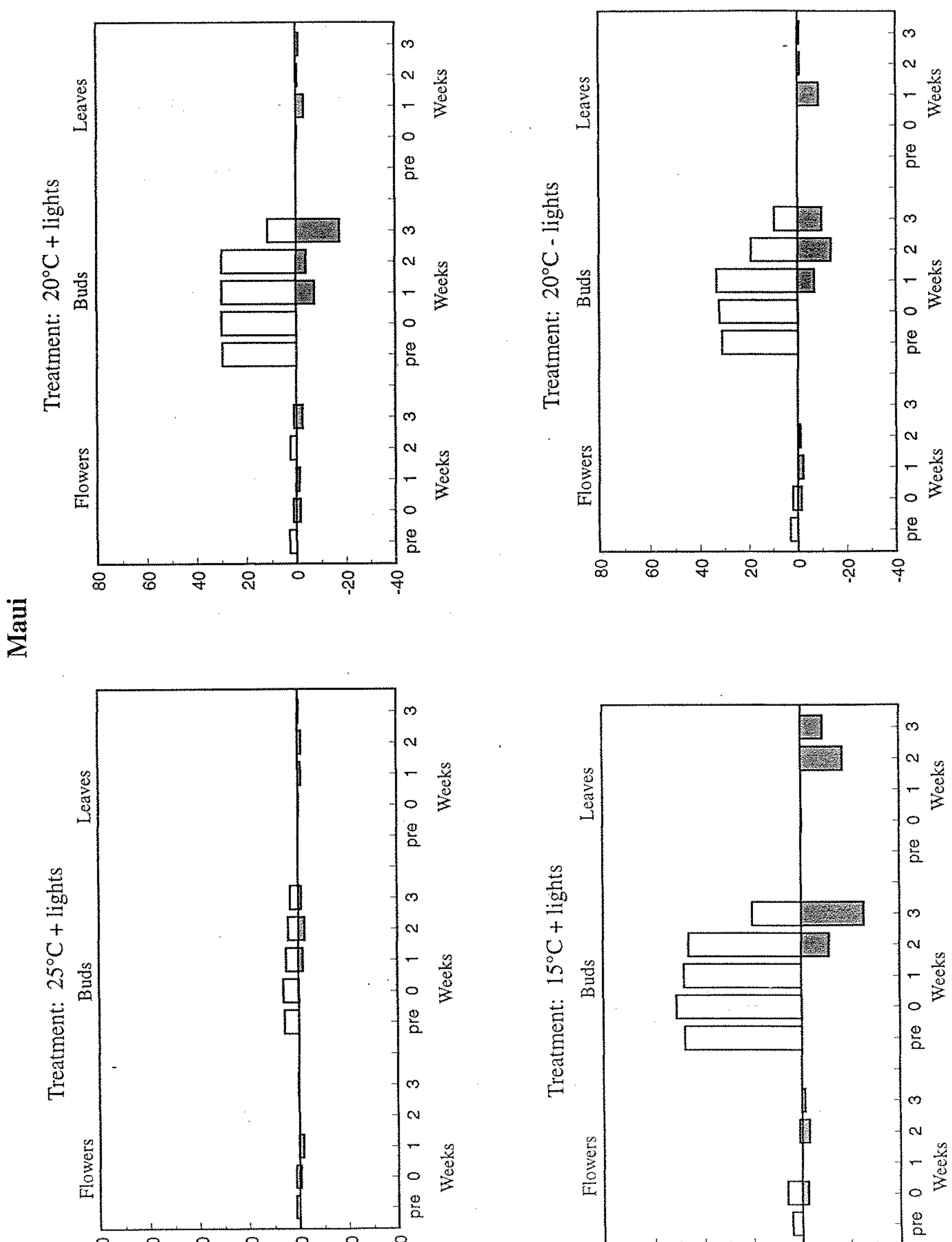
APPENDIX VII

Figure 12



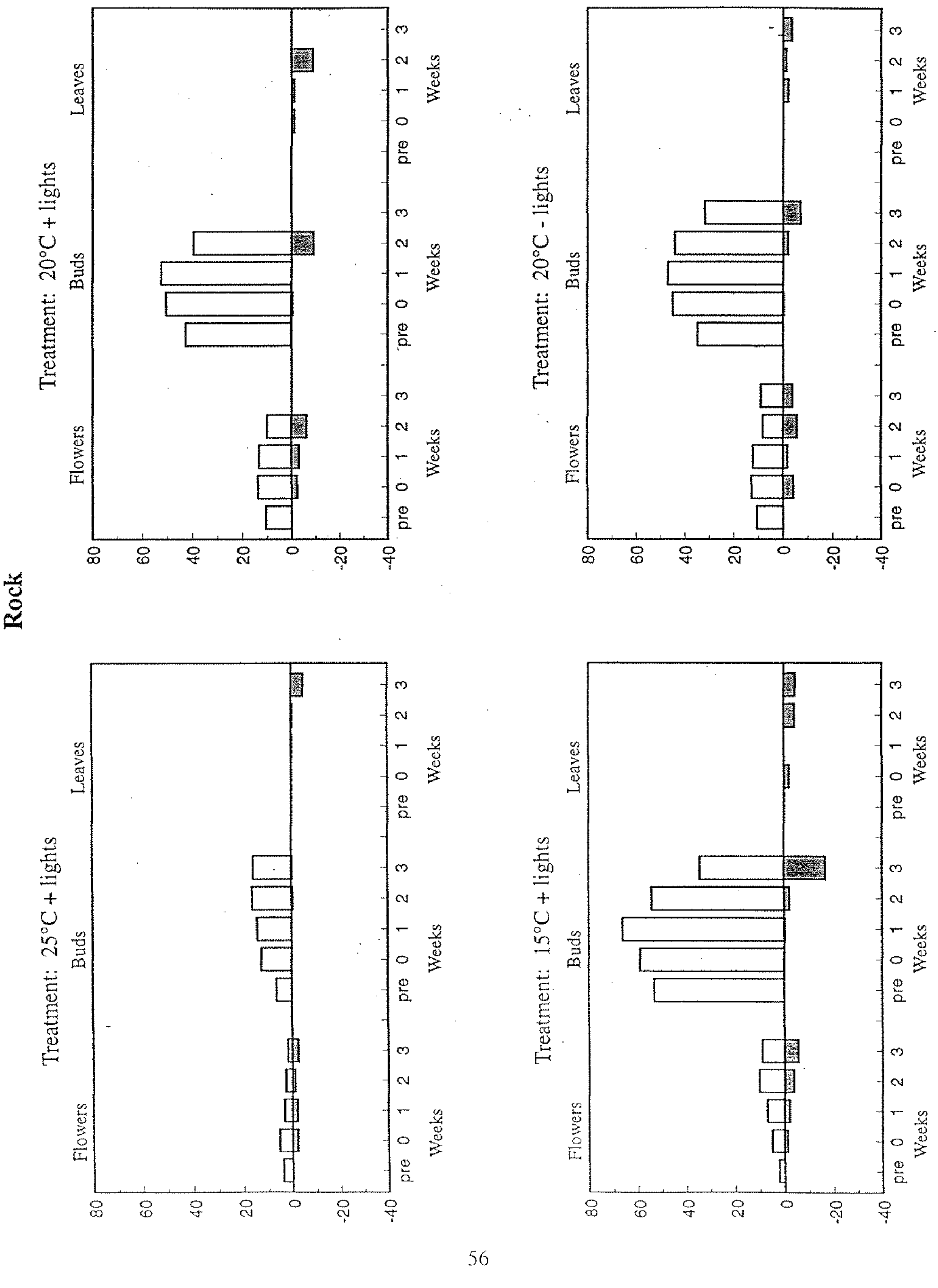
APPENDIX VII

Figure 13



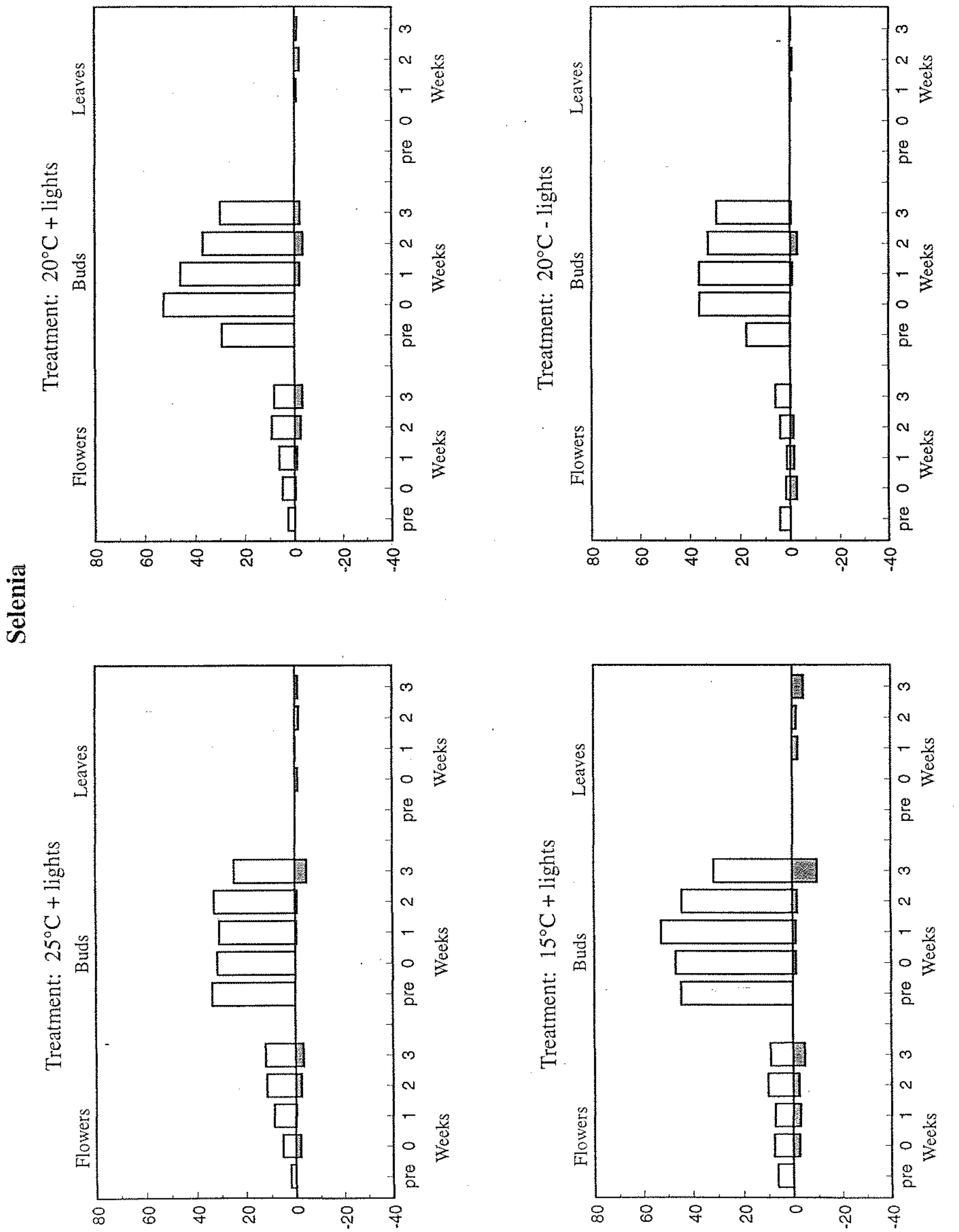
APPENDIX VII

Figure 14



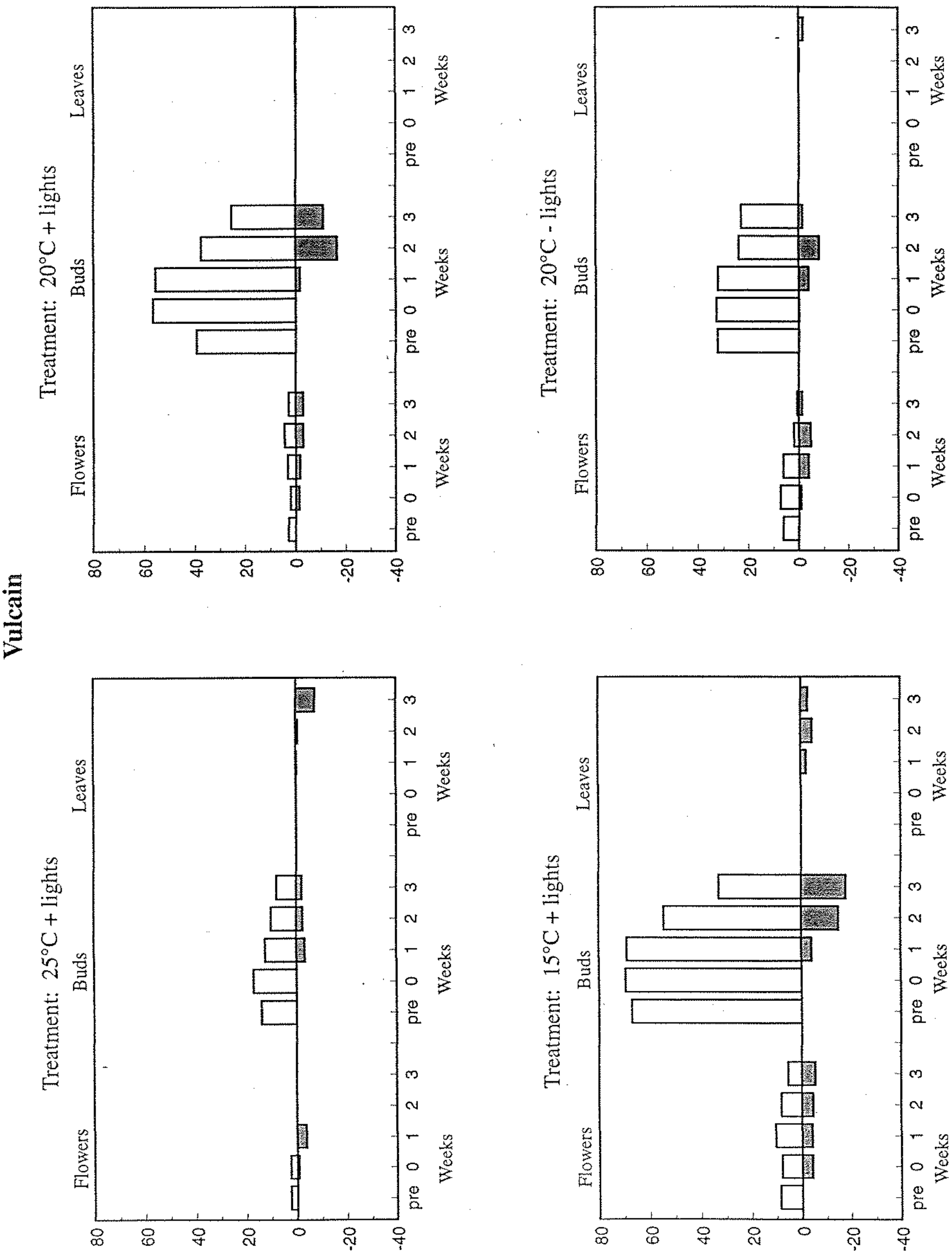
APPENDIX VII

Figure 15



APPENDIX VII

Figure 16



APPENDIX VIII

Plate 1: Treatment comparison at marketing

Treatments	20°C no lights	15°C 2500 lux	20°C 2500 lux	25°C 2500 lux

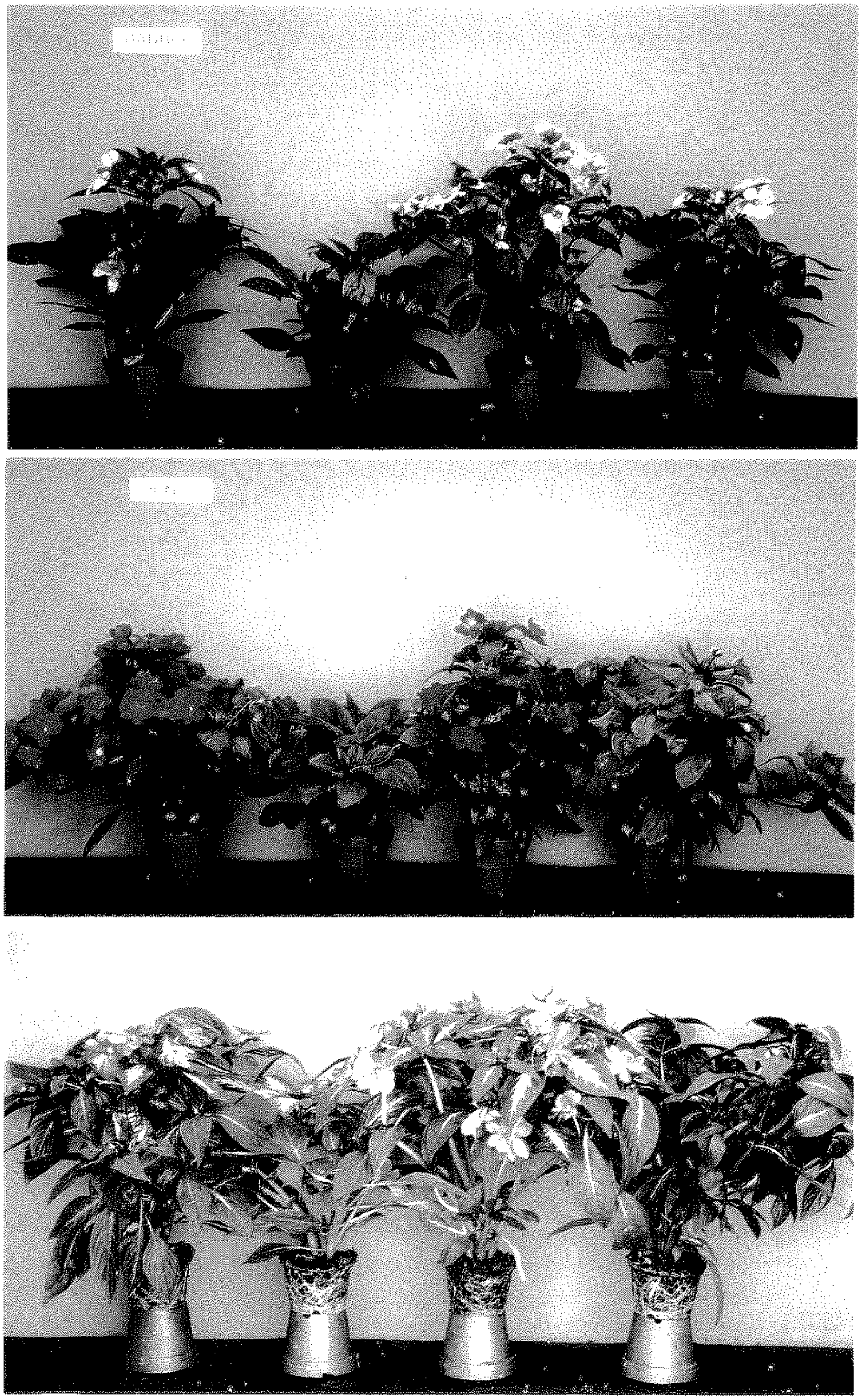
APPENDIX VIII

Plate 2: Treatment comparison at marketing

Treatments	20°C no lights	15°C 2500 lux	20°C 2500 lux	25°C 2500 lux

APPENDIX VIII

Plate 3: Treatment comparison at marketing



Treatments	20°C	15°C	20°C	25°C
	no lights	2500 lux	2500 lux	2500 lux

APPENDIX VIII

Plate 4: Treatment comparison at marketing

Treatments	20°C no lights	15°C 2500 lux	20°C 2500 lux	25°C 2500 lux

APPENDIX VIII

Plate 5: Treatment comparison at marketing

Treatments	20°C no lights	15°C 2500 lux	20°C 2500 lux	25°C 2500 lux

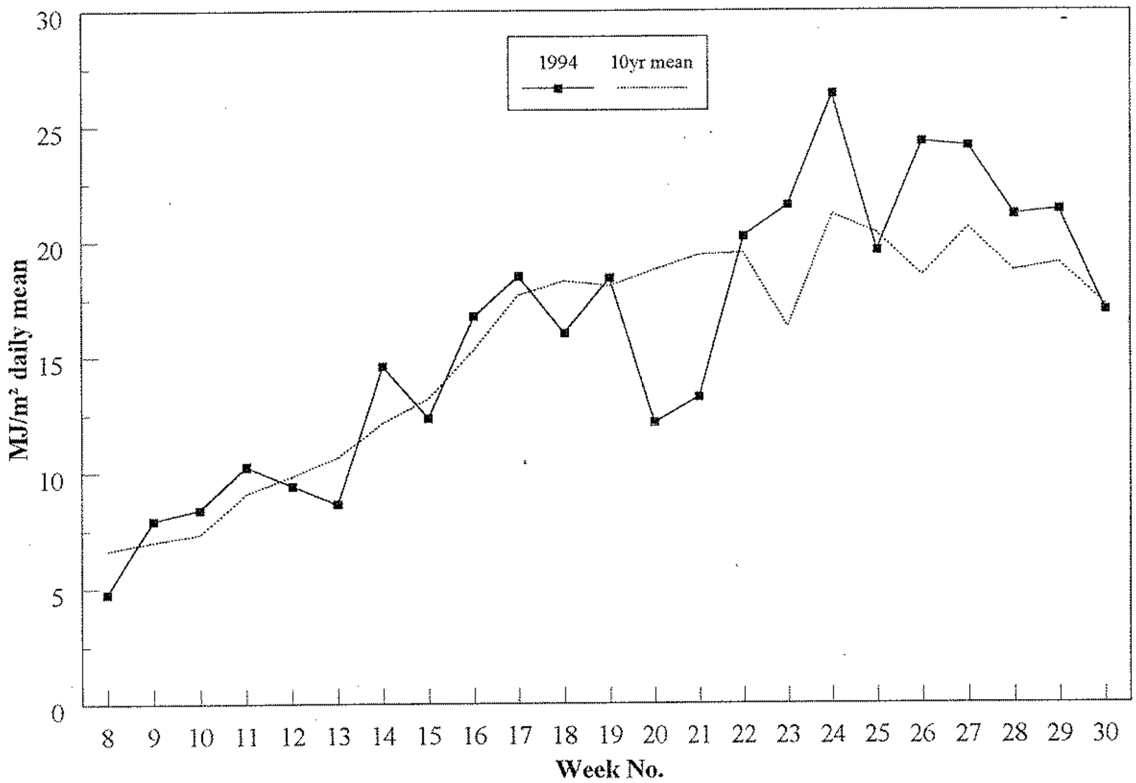
APPENDIX IX

Varietal Performance

Cultivar		Production	Shelf-life
Anaea	C	Red, green leaf, med. vig Good. Plants vig - higher quality under lights	Less flower drop from plants lit in production
Antigua	P	Orange/red, dark green leaf, compact. Benefits from lights, good flower colour and held above foliage.	Poor - 7-10 days flowers and buds drop
Aruba	P	Purple, dark leaf, compact. Flowers at canopy level.	Lighting in production helped.
Blue	P	Light pink, green leaf, compact. Little benefit from lighting.	Average. Flowers paled quickly at low light.
Bolero	P	Purple, dark green leaf, med vig. Good - lighting increased flowering	Held flowers well and colour good.
Cha Cha	P	Red/purple, dark green-red leaf, compact. 20°C+ lights best. Flowers prominent.	Good. Lit plants held flower and colour well.
Danbee	C	Pink/orange, dark green/red, compact. Benefit from lights.	Good. Held flowers well.
Dunya	C	Lilac, dark green, compact. Little benefit from lighting.	Lighting in production an advantage.
Eurema	C	Orange, var. leaf, med. vig. Too vig. for 10 cm at high temp.	Average - better when grown cool.
Lanai	P	Red, dark green leaf, med vig. Lighting advantageous.	Good. Held flowers well.
Lindyhop	P	Light purple, dark green leaf, med. vig. Flowers prominent - good	Variable. Sudden bud/ flower drop.
Marpesia	C	Red, dark leaf, vig. Over-vigorous - poor quality	Poor quality plants.
Maui	P	Coral red with eye, dark leaf, compact. Little benefit from lights.	Average - flowers drop then flowers again.
Rock	C	Violet, dark leaf, very vig. Increased flowering under lights.	Flowers held well and good colour.
Selenia	C	Scarlet, green leaf, med. vig. Lighting beneficial.	Little flower drop.
Vulcain	C	Light pink, dark var. leaf, compact. Cooler best, little added gain from lights.	Open flowers throughout.

APPENDIX X

Figure 1. Solar radiation at HRI Efford



APPENDIX XI

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

1. TITLE OF PROJECT

Contract No: PC80a
Contract date: 14.3.94

NEW GUINEA IMPATIENS: EXTENDING THE GROWING SEASON AND IMPROVING PLANT PRODUCTION AND SHELF LIFE USING CULTURAL AND CHEMICAL MEANS

2. BACKGROUND AND COMMERCIAL OBJECTIVE

The production of New Guinea Impatiens is generally limited to the summer months since problems of bud opening/bud drop have been experienced when grown under poor light. However, with the introduction of a range of new varieties and the potential of the crop as a pot plant, further aspects of its culture need to be examined and schedules produced for cropping at different times of the year. The first trial in 1993 at HRI Efford under project PC80 showed little benefit from the use of supplementary lighting on plant growth in terms of quality and production time when grown at a standard temperature of 18°C, nor were any problems encountered relative to bud drop under shelf life conditions in this trial. Consequently the crop would appear to have greater potential for out of season production than hitherto envisaged. The trial highlighted some areas requiring further work: Varietal performance relative to vigour of growth and production time, pot size and spacing required for different markets and management for targeting sales at different times of the year need following up. Very little work has been carried out on New Guineas worldwide but a literature search revealed that flowering may be affected by a combination of temperature and light (Simmons 1982). Simmons showed that at 15°C the time taken for flower initiation is greatly reduced but the rate of flower development is greater at 25°C with a strong response to photoperiod. His work also confirmed that at 18°C supplementary lighting has little effect on plant development.

The scope of work in this project would concentrate on out of season production over the winter period but starting earlier than 1993 in Week 1 to target the Easter markets. The varietal response to the cultural treatments would also need to be examined and a range of cultivars selected by growers as potential performers for the future would be used. A second trial drawing on the data from the January trial and the 1993 work would allow more further examination of more promising treatments to be followed up in conjunction with other cultural factors more applicable for summer bedding production.

The crop must be carried through to assess treatment affects on post harvest properties of the plants and to provide confirmation of shelf life and/or not of flower 'sticking' needs. Whether bud drop could be associated with nutrition rather than light needs investigating.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

Improved quality of final plant giving better shelf life for retailing and home environment. Economic assessments would be made to compare treatments and schedules. A greater understanding of the cultural requirements for successful early season production of New Guineas.

Additional benefits may occur in reduction of labour use both in production and harvesting whilst maintaining quality standards of UK product.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

To assess the response of a range of varieties to cultural and chemical treatments in early season New Guinea Impatiens production.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

HRI Efford: PC80 using supplementary lighting and anti-ethylene compounds to improve shelf-life of pot plants.

PC80 second trial and observation trials carried out at Lee Valley EHS (Farthing 1984) and at HRI Efford (Sapsed 1990) showed that effects of Alar and Bonzi on New Guinea Impatiens appeared to vary with variety.

Simmons 1982 showed that temperature in combination with light affects flower initiation and subsequent development of New Guinea Impatiens. This needs testing under UK conditions.

6. DESCRIPTION OF THE WORK

Trial 1. To start January 1994.

Cultivars	-	Anaea	Saturina
		Delias	Samoa
		Maui	Antigua
		Aruba	Bolero
		Blue	Lindyhop
		Cha Cha	Danbee
		Dunya	Eurema
		Selenia	Vulcan

These cultivars have been selected with reference to the 1993 trials and individual New Guinea Impatiens grower's experience to include types which cover a range of flower and foliage colours, from both the Paradise and Classic series, show potential in terms of plant quality but are difficult to flower uniformly and hence grow economically.

Treatments -

Temperature/lighting treatments

i. 25°C with 2500 lux supplementary lighting for 12 hours
ii. 20°C with 2500 lux supplementary lighting for 12 hours
iii. 15°C with 2500 lux supplementary lighting for 12 hours
iv. 20°C without lighting

Shelf-life treatments:

All plants given a simulated market run prior to shelf-life of 3 weeks.

Design:

Unreplicated trial with the main plots of temperature and lighting in 4 ebb and flow floor compartments in K-block.

Blocks of each variety within the compartments will be in the same geographic location. Each varietal block will consist of 2 x 20 plants/compartment.

Culture: To be grown in 10 cm pots.
4°C DIF drop for 2 hours from sunrise/Standard PGR regime should growth control appear necessary.
Routine IPM programme for pest and disease control.

Records:

1. Crop diary
2. P & D assessments plus physiological damage to foliage/flower development
3. Time to 50% flowering
4. Harvesting: Final growth and quality assessments
5. Shelf-life and transportation damage assessment
6. Photographs at all stages as appropriate

Trial 2. To start April 1994

This trial would draw on data from the January trial and the 1993 trials allowing for more promising treatments to be followed up. Lighting would be less applicable at this time of year but the temperature/light relationship may well be better understood so that it can be incorporated with other cultural factors such as shading, nutrition, growth regulation and plant densities.

'Shelf-life' will be assessed by bedding out observations.

Further bedding out and Hanging basket assessments will be undertaken in the Spalding area.

7. **COMMENCEMENT DATE AND DURATION**

Start date: 01.01.94; duration 12 months.

The experimental work will be completed by the autumn and the final report will be produced by the end of December.

8. **STAFF RESPONSIBILITIES**

David Hand (Project Leader)	HRI Efford	
Harry Kitchener	ADAS Huntingdon	
HDC Co-ordinator:	Steve Morley	P.A. Moermans Spalding

9. **LOCATION**

HRI Efford, Lymington, Hampshire.
Spalding area.