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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 II (1993)

Effect of Temperature and Plant Density

HDC PC80

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CONTENTS

Final Report February 1996

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

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Key Words: New Guinea Impatiens, Bedding Plants, DROP, Plant Density, Bonzi, Garden Performance

1. RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

1.1 APPLICATION

The aim of this study was to examine the effect of temperature (DROP) and plant spacing on the growth and flowering of a range of New Guinea Impatiens cultivars.

Spacing had a major influence on final plant quality, and plants should be spaced promptly to avoid stretching.

The use of chemical plant growth regulators, in this case Bonzi (Paclobutrazol) proved effective for some cultivars but cannot be relied upon to give adequate growth control for the whole range of cultivars in commercial production.

The use of DROP techniques can be successfully employed to control plant height in New Guinea Impatiens.

1.2 SUMMARY

This second trial of 1993 at HRI Efford evaluated methods for controlling plant height when grown in 13cm pots for the summer market. The same 10 cultivars were used as in the first trial and again the plants were grown at 18°C day and night.

Growth control was evaluated using a Bonzi drench (Paclobutrazol) at 1.25ml/litre, a temperature drop of 4°C for two hours from sunrise (DROP) and growing the plants at final densities of 16 or 25 plants/m^2. The aim of the trial was to determine the effect of these treatments on plant quality and optimal utilization of glasshouse space. The 'garden performance' of all varieties was then tested.

Results indicated that the more compact, Paradise types, showed greater potential for growing at higher plant densities as they inherently need less growth regulation. The 'non' growth regulated Classic types at 25 plants/m^2 were more stretched than those grown at 16 plants/m^2. The optimum plant density for later season production of 12/13cm pots is probably 20 plants/m^2 on the basis that a range of cultivars would be grown in any one growing environment.

Although the Paradise types showed more potential for high density production with little need for growth regulation it should be noted that three of the varieties - Samoa, Papete and Tobago - took approximately two weeks longer to reach the marketing stage than the other seven cultivars under trial. A further potential disadvantage of the Paradise series is the lack of variegated leaf forms, a trait which is strong in the old varieties and which

has considerable appeal to the consumer. These results emphasise the need for careful cultivar selection to optimise production efficiency without loss of the plant's main attributes; *viz.* foliage colour, flower colour and plant habit.

The following table summarises the main response to growth control of the cultivars tested:

Cultivar Characteristics - HRI Efford Trials

Cultivar	Type	Flower Colour	Growth Control Response		General Comments
			DROP	Bonzi	
Samoa	P	White	*	°	Slow to flower in Summer
Barbados	P	Red	*	°	
Papete	P	Purple	*	*	Slow to flower in Summer
Tobago	P	Pink	*	°	Slow to flower in Summer
Maui	P	Red-orange	*	*	
Aruba	P	Magenta	*	*	
Anaea	C	Dark red	*	*	
Selenia	C	Red-orange	*	*	Slow to flower early season
Delias	C	Pink	*	*	Suitable for 10cm pot production
Aurore	C	Dark orange	*	*	Slow to flower early season

KEY:

P = Paradise type

C = Classic type

* = Some height control

° = No height control

Grower Trials

A total of 48 new cultivars were selected from trials seen at Kiel in Germany. These were grown on two commercial holdings, in Lincolnshire and West Sussex. Cultivar performance was assessed on the holdings, followed by bedding out at Spalding and Plymouth respectively, to assess their garden performance in these two different climatic regions. Plants were supplied by Dummen and Danzinger and were assessed for their production time, leaf and flower colour, plant habit and flower production. Full results are presented in Appendices III and IV, pages 30-38.

Pot Plants

The best cultivars in this trial for pot production were:-

Adagio
Antigua
Agadoo
Aruba
Barbados
Bolero
Chanson
Kanon
Octavia
Partitur
Twist

Bedding plants

The best cultivars were:-

Chanson
Partitur
Adagio
Motette
Lanai
Barbados
Tobago
Papete
Debka
Selenia
Marpesia
Maui
Anaea
Twist
Ballet
Sirtaki
Tahiti
Terinoa
Aruba

1.3 CONCLUSIONS

- The new cultivars have considerable potential as a pot and bedding plant but careful selection of type has to be made as cultivar response to different cultural regimes can vary.

- The Paradise Series of New Guinea Impatiens have the benefit of compactness enabling them to be grown at higher plant densities than the Classic types, giving greater throughput per unit area.

- The Paradise Series show good shelf-life performance with little bud/flower drop occurring.

- There is an indication that the anti-ethylene compounds, Chrysal EVB and STS can act as flower stickers for New Guinea Impatiens.

- The Paradise Series performs well bedded out.

- The Paradise Series can be successfully grown without the need for chemical plant growth regulators.

- Of the ten cultivars tested all showed some growth control from the use of DROP.

- The use of DROP had no detrimental effects on subsequent plant quality and performance.

- With the exception of Selenia, a single Bonzi application at the rate of 1.25ml/l delayed flowering of New Guinea Impatiens.

- Cultivar performance can be significantly affected by propagation source.

- Certain cultivars are more suited to certain times of the year e.g. Samoa performed well in the early season trial but was slow to flower during the summer.

- Certain cultivars have a plant habit more suited to production in smaller pots e.g. Delias for 10cm pot production.

2. EXPERIMENTAL SECTION

2.1 INTRODUCTION

New Guinea Impatiens (Impatiens X Hybrida (I. Hawkeri)) 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 the earlier HDC study, PC 80, Part I, 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.

The production of New Guinea Impatiens has traditionally been limited to the Summer months since problems of non-uniform flowering, slow establishment and bud abortion meant that the crop could not be grown economically under the poorer winter light conditions: this constraint on early production was investigated in the first trial at HRI Efford in 1993. During the summer months the traditional Classic cultivars have been variable in terms of growth, and growth control has been a key issue. To date, chemical growth regulators have only achieved a limited success on New Guinea Impatiens with Alar and Bonzi performing best. With the advent of the comparatively new growth control technique of DROP it was proposed that this project look at the performance of Bonzi, DROP and plant densities on a range of new and old cultivars in order to ascertain which regimes would be most beneficial for successful New Guinea Impatiens production.

The effects of these treatments were subsequently tested in garden performance on ten cultivars; six Paradise and four Classic types. The trial conducted at HRI Efford was supplemented by two commercial trials to assess the potential of the new cultivars as pot and bedding plants.

2.2 OBJECTIVES

- To evaluate a number of growth control techniques, specifically plant density and temperature (DROP) and to quantify their effects on a range of cultivars of New Guinea Impatiens.

- To assess the performance of a range of cultivars at both HRI Efford and on commercial sites for their suitability as both pot plants and bedding plants.

2.3 MATERIALS AND METHODS

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2.3.1 Site

The plants were grown on Ebb and Flood floors in four compartments of the multifactorial glasshouse "K" Block.

2.3.2 Cultivars

The plants for the trial were brought in from Royal Eveleens as rooted cuttings and potted in week 22.

Paradise Types	**Others**
Samoa	Anaea
Barbados	Selenia
Papete	Delias
Tobago	Aurore
Maui	
Aruba	

2.3.3 Treatments

Temperature Treatments

1. DROP of 4°C for 2 hours at sunrise. Temperature compensation was utilized to ensure the same 24h average as 2.

2. No DROP, plants grown at a day/night temperature of 18°C

Plant Density Treatments

1. Grown at a final spacing of 16 plants/m^2

2. Grown at a final spacing of 25 plants/m^2

Plant Growth Regulator Treatments

1. Paclobutrazol as Bonzi (1.25ml/l) applied as a drench once plants achieved a height of 15cm

2. No chemical growth regulant applications

Shelf-life Treatments

The garden performance of plants subjected to the above temperature, plant density and plant growth regulator treatment was monitored on a bedding site.

Additional Observation

Plants were given a simulated market run prior to a shelf-life evaluation of 18 days under "home" conditions. These plants had been treated with the following anti-ethylene compounds:

1. Untreated control

2. Sodium silver thiosulphate (argylene)

3. Chrysal EVB (non silver ethylene inhibiting)

2.3.4 Experimental Design

2	plant densities
x	
2	temperature regimes
x	
2	PGR treatments
8	treatments
x	
10	varieties
80	plots in total

Plot size: 13 plants per plot at pot thick stage
8 plants per plot at full spacing

The trial layout is given in Appendix I, page 24.

2.3.5. Cultural Details

Plants were potted into 12cm AX optipots (2 tier drainage) using Fisons Levington C1A growing media plus Dolodust at 225g per 75 1 on 26/05/93. Once laid out in the compartments the plants were given a drench of Iprodione (as Rovral 1.0g/l) as a preventative treatment against *Botrytis* and a further application was made on 24/06/93. The concrete floors were drenched with water daily to increase the humidity of the growing environment.

Effective sciarid fly control was achieved using a compost drench of Nemasys (*Steinernema Bibionis*) applied on 10/06/93. Weekly introductions of the biological predators *Aphidoletes aphidomyza, Encarsia formosa* and *Phytoseiulus persimilis* for the control of aphids (*Aphididae*), glasshouse white fly (*Trialeurodes varporariorum*) and two spotted spider mite (*Tetranychus urticae*). In addition six weekly introductions of *Amblyseius cucumeris* were made for the control of western flower thrips (*Frankliniella occidentalis*).

Maui, Aruba, Aurore, Delias and Anaea were moved to their final spacing on 07/07/93. The slower growing varieties of Samoa, Barbados, Papete, Tobago and Selenia were moved to their final spacing on 20/07/93.
Liquid feeding commenced at every watering from week 26 using Kristalon Blue 19:6:20 + 3 diluted 1 to 200 to give 95 ppm N, 30 ppm $P_2 0_5$ and 100 ppm $K_2 0$.

The chemical growth regulant treatment of Paclobutrazol as Bonzi was applied to the cultivars Maui, Aruba, Aurore, Delias and Anaea on 01/07/93 and to Samoa, Barbados, Papete, Tobago and Selenia on 15/07/93.

The plants were bedded out at HRI Efford into Waterstsock series soil, a slightly stony sandy silt loam on the 03.08.93 to monitor garden performance.

For the additional observation on shelf-life, chemical treatments (flower stickers) were applied to spare plants (three plants of each variety per shelf-life chemical treatment) as follows:

Table 1. Shelf-life Chemical Treatments

Treatment	Dates of Application
Chrysal applied at 5ml/l	15/07/93, 22/07/93 and 29/07/93
Argylene applied at 1g/l	15/07/93

These anti-ethylene compounds were applied as per label recommendations.

2.3.6 Assessments

Throughout the course of the trial, notes were made on plant development including plant habit, bud and flower development. The time to 50% flowering was recorded.

Plant Growth Assessments at Marketing

At the point of marketing, when at least half of the plants in a varietal block were in flower, the following assessments were made:

Plant height - measured to the nearest 0.5cm taken from the rim of the pot to the top of the canopy.

Plant spread - Measured to the nearest 0.5cm taken as the measurement across the widest part of the plant canopy.

Plant quality score - (3 = best, 1 = unmarketable)

Bud and flower count

Shelf-life

Plants for the additional observation on the use of shelf-life chemicals were sleeved, boxed, and transported to Birmingham and back to simulate a market run. On their return the plants were retained in their boxes under packhouse conditions for 3 days. The sleeves were then removed and the plants placed in shelf-life conditions of 20°C and 1000 lux for a 12 hour day.

Plants were assessed for bud and flower numbers over 18 days.

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

B COMMERCIAL TRIALLING

2.3.8 Sites

Trials were conducted on two growers holdings to assess the performance of 48 new cultivars under UK conditions. Rooted cuttings from the plant suppliers Dummen and Danzinger were potted in week 20 and grown under the growers normal commercial conditions in 10cm pots. The participating nurseries were:

P A Moermans, Raceground Nursery, Spalding, Lincs
Hill Bros., Chichester, West Sussex.

Plants were either grown through to marketing stage as a pot plant, or were bedded out earlier to assess their garden performance.

2.3.9 Cultivars

The cultivars trialed were:

Danzinger		**Dümmen**
Samoa	Twist	Chanson
Lanai	Ballet	Fanfare
Agadoo	Sirtaki	Partitur
Salsa	Bora Bora	Adagio
Blues	Danova	Allegro
Barbados	Can Can	Kanon
Tobago	Tonga	Motette
Papete	Tahiti	Melodie
Helyode	Terinoa	Sphinx
Bolero	Antigua	Octavia
Calypso	Hilone	
Steps	Hudson	
Cha Cha	Hanko	
Danbee	Aruba	
Lindyhop	Maui	
Debka	Anaea	
Delias	Fiji	
Selenia	Dunya	
Marpesia	Strunie	

2.3.10 Bedding out

Plants were bedded out in week 26 at Springfields, Spalding and at Bere Alston, Plymouth at two spacings: 30 x 30 cm and 45 x 45 cm. Following watering in the plants post planting no further cultural practices (eg. dead heading, tidying up of plants) were carried out except for hand weeding.

2.3.11 Assessments

Pot Plants

Notes were made by the growers of the time taken to flowering and assessments were carried out in week 31 on plant habit, foliage and flower colour (see Appendix III, p30 to 32). These records helped to decide on the varieties potential as a pot plant at marketing stage.

Bedding Plants

Plants were inspected in July and a final assessment was made on the 15/09/93 at Springfields. A further assessment was planned for mid October but the plants had suffered severe frost damage. Unfortunately the Bere Alston site was flooded during the summer rendering comparisons of cultivar performance in the beds meaningless. The following assessments were made:

1. Flower colour

2. Flower performance score (0 = very poor, 3 = satisfactory, 5 = very good)

3. Overall performance assessments (0 = very poor, 3 = satisfactory, 5 = very good)

4. General comments specific to the cultivar

3. RESULTS

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3.1 PRODUCTION TIME

The time taken to reach marketing stage was not affected by the temperature regime. However, the application of Bonzi tended to delay flowering by about two days except for Selenia where an advancement of flowering of two to three days was observed. Plant density had some effect on flower development with the closer spacing of 25 plants/m^2 resulting in earlier flowering. The greatest difference was between cultivars; with Maui reaching marketing stage 19 days earlier than Tobago, (Table 1).

Table 1: Marketing dates for non-Bonzi treated plants

Cultivar	Final plant density	
	16 plants/m^2	25 plants/m^2
Samoa	07.08.93	07.08.93
Barbados	23.07.93	21.07.93
Papete	05.08.93	04.08.93
Tobago	07.08.93	08.08.93
Maui	21.07.93	22.07.93
Aruba	26.07.93	23.07.93
Anaea	22.07.93	22.07.93
Selenia	28.07.93	26.07.93
Delias	26.07.93	21.07.93
Aurore	29.07.93	23.07.93

3.2 ASSESSMENTS AT MARKETING

The assessments at marketing can be found in Appendix II, Tables 1 to 6, pages 25 to 29. Growth control in terms of plant height was achieved to differing degrees on all cultivars using DROP at 16 plants/m^2 spacing (see Appendix II, Table 1, page 25). However, the effect of DROP was not so pronounced at the higher plant density of 25 plants/m^2 (see Appendix II, Table 2, page 26) where the competition for light may have encouraged stretching.

Effects of growth control in respect of maximum plant spread are detailed in Appendix II, Tables 3 and 4, pages 27 and 28. Although reductions in plant spread are noticeable the trends were not as clear as those for height control.

The use of Bonzi gave some growth control although the results indicate that Samoa, Barbados and Tobago did not respond to this chemical growth regulator. When Bonzi was used in conjunction with DROP, despite slight improvements in height control it often had a detrimental effect on plant quality (see Appendix II, Tables 5 and 6, page 29).

The higher scores for quality tended to be for plants grown at 16 plants/m^2.

3.3 GARDEN PERFORMANCE

All cultivars performed well when bedded out with little treatment effect evident. The crop survived until the first frost in early October and up to that date had produced several flushes of flowers. This confirmed the suitability of Paradise types for the garden in addition to those of the Classic series. (Appendix IV, pages 33-38.)

3.4 SHELF-LIFE

The additional observation which consisted of treating some plants as indoor pot plants and applying flower stickers (anti-ethylene compounds) as preventative treatments against flower abscission proved inconclusive and hence detailed results are not presented. However, the relative absence of flower/bud drop would suggest that the newer varieties have potential as pot plants.

B COMMERCIAL TRIALLING

3.5 CULTIVARS

An additional observation was done at Hill Brothers on receipt of five of the trial cultivars (Maui, Barbados, Aruba, Papete, Lanai) in the same week from another supplier (Royal Eveleens). These cuttings when grown on in the same glasshouse flowered up to a week earlier than the material provided for the trials. This would indicate that in addition to cultivar type considerable variation in performance could arise from the source of New Guinea cuttings.

Pot Plants

The best cultivars in this trial for pot production were:-

Adagio
Antigua
Agadoo
Aruba
Barbados
Bolero
Chanson
Kanon
Octavia
Partitur
Twist

See Appendix III (pages 30 to 32) for full details.

Bedding Plants

The best cultivars were:

Chanson
Aruba
Partitur
Adagio
Motette
Lanai
Barbados
Tobago
Papete
Debka
Maui
Anaea
Twist
Ballet
Sirtaki
Selenia
Marpesia
Tahiti
Terinoa

See Appendix IV (pages 33 to 38) for full details of the assessment carried out in September 1993.

The two plant spacings of 45 x 45cm and 30 x 30cm had some effect, with the closer spacing allowing the plants to cover the soil well for a comparatively late planted crop. The plants were killed by frost mid-October prior to the second scheduled assessment.

From the end of August the summer of 1993 was both wet and cold (Appendix V, page 39) in the part of Lincolnshire where the trial was conducted. These adverse weather conditions provided a robust test of garden performance and cultivars which scored 4 and above were those which proved to be most tolerant of the prevailing conditions.

4. DISCUSSION

In recent years a large number of new varieties have become available to the UK grower expanding the range of colours, leaf types and plant habits. These varieties, particularly the more compact 'Paradise' series, have shown characteristics favourable for the indoor pot plant market. However, for this potential to be fully exploited some fundamental aspects of the crops' culture needed to be examined in addition to establishing production schedules for cropping at different times of the year.

This year, trials have indicated that the traditional problems of non-uniform flowering, slow establishment, growth control and flower drop/bud drop are not so prevalent in the newer more compact Paradise series. Indeed, the compactness of some of the cultivars will enable the crop to be grown more economically at higher plant densities but much more work is required to accurately schedule the crop.

Growth Control

The application of Bonzi delayed flowering in all varieties except Selenia where there was an advance in flowering. It was also noticed that Bonzi had no growth control effect on three Paradise cultivars - Barbados, Samoa and Tobago, whilst the use of DROP had some effect on all cultivars. This combined with the results of previous work carried out by John Farthing at Lea Valley where it was shown that several New Guinea cultivars do not respond to the chemical growth regulator daminozide (Alar) would suggest that the use of the growth regulators evaluated to date has not been particularly effective.

The results indicated that the more compact, Paradise types, showed greater potential for growing at higher plant densities as they need less growth regulation. The 'non' growth regulated Classic types at 25 plants/m^2 were more stretched than those grown at 16 plants/m^2 and this is reflected in the lower quality scores (Appendix II, Tables 5 and 6, page 29). In practice, a grower will probably grow a range of cultivars in one glasshouse environment so a compromise spacing of 20 plants/m^2 would probably be nearer to the ideal as some desirable attributes of the Classic cultivars, such as variegation of the foliage have not yet been bred into the new cultivars.

Although the Paradise types showed more potential for high density production with little need for growth regulation it should be noted that three of the cultivars - Samoa, Papete and Tobago - took approximately two weeks longer to reach the marketing stage than the other seven trial cultivars. This emphasises the need for careful cultivar selection to optimise production efficiency.

The following table summarises the chief growth control responses by the varieties tested:

Varietal Characteristics - HRI Efford Trials

Variety	Type	Flower Colour	Growth Control Response		General Comments
			Drop	Bonzi	
Samoa	P	White	*	°	Slow to flower in Summer
Barbados	P	Red	*	°	
Papete	P	Purple	*	*	Slow to flower in Summer
Tobago	P	Pink	*	°	Slow to flower in Summer
Maui	P	Red-orange	*	*	
Aruba	P	Magenta	*	*	
Anaea	C	Dark red	*	*	
Selenia	C	Red-orange	*	*	Slow to flower early season
Delias	C	Pink	*	*	Suitable for 10cm pot production
Aurore	C	Dark orange	*	*	Slow to flower early season

KEY:

P = Paradise type

C = Classic type

* = Some height control

° = No height control

Commercial Trials

The commercial trials highlighted some of the cultivars with the shortest production time (8 weeks) but the performance from year to year and from cuttings received from other propagators have yet to be determined. These trials also emphasized the range of New Guinea Impatiens types and colours available which, should the crop be able to be grown to a more predictable programme, could see it rivalling the *Geranium* market.

Considering the origins of the New Guinea Impatiens species being from a warmer climate than that of the British Isles the encouraging garden performance by some of the cultivars in a particularly poor summer emphasised the potential of the crop to the bedding industry. Most cultivars performed well when bedded out with little treatment effects evident. The crops survived until the first frost in early October and up to that date had produced several flushes of flowers. This confirmed the suitability of Paradise types for the garden in addition to the Classic varieties.

5. CONCLUSIONS

- The new cultivars have considerable potential as a pot and bedding plant but careful selection of type has to be made as cultivar response to different cultural regimes can vary.

- The Paradise Series of New Guinea Impatiens have the benefits of compactness to enable them to be grown at higher plant densities than the Classic types enabling greater throughput per unit area.

- The Paradise Series show good shelf-life performance with little bud/flower drop occurring.

- There is an indication that the anti-ethylene compounds, Chrysal EVB and STS can act as flower stickers for New Guinea Impatiens.

- The Paradise Series performed well on bedding out to test garden performance.

- The Paradise Series can be successfully grown without the need for chemical plant growth regulators.

- Of the ten cultivars tested all showed some growth control from the use of DROP.

- The use of DROP has no detrimental effects on subsequent plant quality and performance.

- With the exception of Selenia, a single Bonzi application applied as a drench at the rate of 1.25ml/l delayed flowering of New Guinea Impatiens.

- Cultivar performance may be significantly affected by propagation source.

- Certain cultivars are more suited to certain times of the year e.g. Samoa performed well in the early season trial but was slow to flower in this trial.

- Certain cultivars have a plant habit more suited to production in smaller pots e.g. Delias for 10cm pot production.

6. RECOMMENDATIONS FOR FUTURE WORK ON NEW GUINEA IMPATIENS

Future work on New Guinea Impatiens will need to investigate the trigger for flower development (possibly MAFF funded) in the hope of achieving more uniform flowering and scheduling of both early and main season crops. The effect of temperature and light on flower initiation and development and the effect on plant quality and subsequent shelf-life should also be evaluated.

Other cultural factors such as nutritional effects on bud drop should be studied in addition to further assessments of new cultivars.

New cultivars suitable for hanging basket production should be investigated as there is a large potential UK market.

Cultivars from different suppliers should be checked to evaluate the amount of variability the new cultivars have when derived from different stock material.

APPENDICES

APPENDIX I

Trial Layout

Treatments	Glasshouse compartment
NO DROP + Bonzi AT 16 PLANTS/M^2	K15
NO DROP - Bonzi AT 16 PLANTS/M^2	K15
DROP + Bonzi AT 16 PLANTS/M^2	K5
DROP - Bonzi AT 16 PLANTS/M^2	K5
NO DROP + Bonzi AT 25 PLANTS/M^2	K10
NO DROP - Bonzi AT 25 PLANTS/M^2	K10
DROP + Bonzi AT 25 PLANTS/M^2	K4
DROP - Bonzi AT 25 PLANTS/M^2	K4

APPENDIX II

Efford: **Results at Marketing**

Table 1. **Plant height (cm) at final spacing of 16 plants/m^2**

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	18.0	21.4	18.1	21.6
Barbados	16.1	18.9	15.5	18.5
Papete	14.7	14.3	15.4	16.1
Tobago	18.2	20.4	17.5	19.8
Maui	13.3	15.9	14.8	17.7
Aruba	15.0	14.9	13.8	15.0
Anaea	11.3	12.3	11.7	14.0
Selenia	14.0	14.1	16.1	17.6
Delias	13.3	15.3	13.4	17.7
Aurore	23.7	22.0	25.0	25.4

Table 2. Plant height (cm) at final spacing of 25 plants/m^2

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	19.1	21.6	19.3	21.2
Barbados	16.4	18.7	17.0	19.9
Papete	14.1	15.7	13.5	16.9
Tobago	16.0	18.2	17.5	17.8
Maui	13.9	17.1	15.7	18.4
Aruba	14.7	15.5	15.0	16.1
Anaea	12.3	14.6	14.7	16.9
Selenia	15.4	14.0	19.0	19.7
Delias	15.9	15.8	13.5	16.5
Aurore	20.6	22.3	20.1	23.3

Table 3. Maximum spread (cm) at final spacing of 16 plants/m²

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	33.2	39.6	38.7	41.3
Barbados	27.9	27.7	30.2	31.9
Papete	30.4	30.4	33.8	30.2
Tobago	35.4	35.3	34.5	36.4
Maui	31.1	34.6	34.7	34.8
Aruba	30.4	33.9	32.3	33.6
Anaea	22.6	24.2	24.8	25.9
Selenia	28.8	28.2	30.4	30.4
Delias	26.3	28.0	27.3	31.3
Aurore	34.2	34.0	34.8	35.8

Table 4. **Maximum spread (cm) at final spacing of 25 plants/m^2**

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	35.6	38.9	34.8	40.2
Barbados	28.4	28.5	28.6	28.4
Papete	29.6	29.9	29.8	31.0
Tobago	30.9	32.9	32.6	33.5
Maui	29.8	35.1	30.3	35.1
Aruba	30.0	30.9	31.7	31.7
Anaea	26.2	26.9	27.3	28.3
Selenia	28.4	30.8	32.7	34.6
Delias	25.8	27.9	28.3	29.1
Aurore	31.2	34.1	31.1	34.2

Table 5. Quality score (1 = unmarketable, 3 = no defects) at final spacing of 16 plants/m^2

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	3.0	2.7	2.8	2.8
Barbados	2.8	2.8	2.8	2.7
Papete	2.8	2.3	2.8	2.8
Tobago	2.3	2.6	2.7	2.8
Maui	2.2	2.7	2.6	2.8
Aruba	2.8	2.9	2.8	2.7
Anaea	1.8	2.3	2.4	2.6
Selenia	2.4	2.9	2.8	2.6
Delias	2.6	2.8	2.7	3.0
Aurore	2.0	2.0	2.0	2.0

Table 6. Quality score (1 = unmarketable, 3 = no defects)at final spacing of 25 plants/m^2

Cultivar	Growth control treatment			
	Bonzi + DROP	Bonzi	DROP	None
Samoa	2.8	2.4	2.7	2.0
Barbados	2.4	2.8	3.0	2.8
Papete	2.4	2.7	2.6	2.8
Tobago	2.7	2.7	2.9	2.9
Maui	2.4	2.7	2.9	2.9
Aruba	2.6	2.4	2.6	2.3
Anaea	2.2	2.8	2.6	2.8
Selenia	3.0	3.0	2.7	2.0
Delias	2.6	2.7	2.9	2.7
Aurore	2.0	2.0	2.0	2.0

APPENDIX III

Commercial Trialling: Results as Pot Plants

Cultivar comparison made in week 31 (from a week 20 potting)

Variety	Plant Shape	Leaf Colour	First Flower Visible	Colour
1 Chanson (D)	Compact, medium, bushy	Green Burgundy tinge	Week 29	Blush pink
2 Fanfare (D)	Compact	Light green/ yellow with red vein	Week 30	Deep salmon pink
3 Partitur (D)	Vigorous but bushy	Bright green	Week 29	Mauve
4 Adagio (D)	Vigorous, bushy	Bright green	Week 30	Pinky orange
5 Allegro (D)	Compact	Bright green	Week 30	Pink with white eye
6 Kanon (D)	Compact, medium size bushy	Medium green	Week 24	Bright red
7 Motette (D)	Initially vigorous but then appears to bush out	Lush green	Week 29	Red
8 Melodie (D)	Vigorous, bushy plant	Deep green, bright red vein	Week 26	Pink, dark eye
9 Sphinx (D)	Compact	Dull, dark green	Week 29	White
10 Octavia (D)	Compact	Dark green	Week 30	Mauve
11 Lanai (Dan)	Small to medium	Dark green	Week 29	Red
12 Agadoo (Dan)	Small and compact	Medium green	Week 28	Deep orange
13 Salsa (Dan)	Small and uneven	Scarlet bronze	Week 28	Orange
14 Blues (Dan)	Bushy	Dark green	Week 29	Salmon pink
15 Barbados	Upright habit	Bright green	Week 29	Orangey pink
16 Tobago (Dan)	Medium to small	Green burgundy	Week 30	Salmon
17 Papete (Dan)	Medium, longish internodes	Deep green	Week 30	Purple
18 Helyode (Dan)	Upright habit, tall	Deep green	Week 28	Pale lilac to deep purple

Variety	Plant Shape	Leaf Colour	First Flower Visible	Colour
19 Bolero (Dan)	Compact	Deep green	Week 27	Rose lilac
20 Calypso (Dan)	Compact, good	Bright green	Week 30	Cerise pink/orange growth
21 Steps (Dan)	Compact	Dark green	Week 26	Brilliant orange
22 Cha Cha (Dan)	Bushy	Red green	Week 30	Pillar box red
23 Danbee (Dan)	Small, compact	Bronze green	Week 31	Salmon orange
24 Lindy Hop (Dan)	Vigorous, upright	Bright green	Week 29	Deep cerise
25 Debka (Dan)	Compact	Green	Week 32	Lilac/dark eye
26 Delias (Dan)	Small, bushy vigorous	Pale green	Week 30	Mauve lilac
27 Samoa (Dan)	Compact, even	Fresh green	Weeek 31	White
28 Selenia (Dan)	Compact and even	Fresh green	Week 31	Orange
29 Marpesia (Dan)	Small, medium, compact	Purple green	Week 30	Red
30 Dunya (Dan)	Vigorous, bushy	Deep green	Week 30	Purple
31 Strunie (Dan)	Upright, vigorous, pushing out at last weeks	Bronze green	Week 31	Light purple
32 Can Can (Dan)	Small	Medium green	Week 30	Orange
33 Tonga (Dan)	Too upright habit	Brown green	Week 29	Lilac pink
34 Tahiti (Dan)	Compact, medium growth	Burgundy green	Week 30	Pink
35 Terinoa (Dan)	Compact, well finished	Dark green/ reddish	Week 28	Purple
36 Antigua (Dan)	Upright,vigorous	Green	Week 29	Orange red
37 Hailun (Dan)	Thin, not bushy	Reddish green	Week 30	White to pink
38 Hudson (Dan)	Small, compact	Green	Week 30	Pale pink
39 Hanko (Dan)	Small, compact	Bronze green	Week 31	Pink
40 Aruba (Dan)	Bushy, compact	Deep green, red undersides	Week 30	Mauve
41 Maui (Dan)	Upright, medium	Purple green	Week 30	Orange pink

Variety	Plant Shape	Leaf Colour	First Flower Visible	Colour
42 Anaea (Dan)	Compact	Medium green	Week 29	Cherry red
43 Fiji (Dan)	Compact	Glossy green	Week 28	Blush pink
44 Twist (Dan)	Small	Bronze green	Week 30	Purple
45 Ballet (Dan)	Vigorous, well shaped	Lush green	Week 32	White
46 Sirtaki (Dan)	Medium bush	Medium glossy green	Week 30	Deep pink
47 Bora Bora (Dan)	Compact, branches well	Green	Week 29	Deep lilac
48 Danova (Dan)	Upright, bushy	Purple green	Week 30	Orange

Plant Suppliers (D) = Dummen through Hollyacre Plants Ltd.
(Dan) = Danzinger

APPENDIX IV

Commercial Trialling: Results as Bedding Plants

Cultivar comparison assessment made at Springfields, Spalding on 15/09/93
Key to valuation of characteristics: 0 - Very poor
3 - Satisfactory
5 - Very good

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
1 Chanson (D)	Blush pink dark crimson centre	3	4	Leaf colour dark green reasonably weather proof vigour moderate
2 Fanfare (D)	Deep Salmon pink	3	3	Leaf colour dark green to burgundy appearance generally good with good vigour
3 Partitur (D)	Mauve carmine	4	4	Leaf colour bronze green with yellow midribs, good appearance and vigour
4 Adagio	Salmon pink	4	4	Vigorous variety cover the ground well
5 Allegro (D)	Pink	2	2	Variety appears to be poor in adverse conditions
6 Kanon (D)	Carmine red	3	3	Foliage green leaves, bronze margin. Overall vigour good but plant tending to be compact
7 Motette	Bright red	3	4	Foliage deep green, good weatherproof variety, colour bright red

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
8 Melodie (D)	Pink crimson eye	2	1	Leaf colour green yellow, overall vigour moderate plants look flat
9 Sphinx (D)	White	3	1	Leaf colour green, vigour appeared to be lacking
10 Octavia (D)	Light mauve	2	3	Vigour very good, foliage dark green
11 Lanai (Dan)	Red	5	4	This variety became more vigorous when warmer weather came, foliage dark green in colour
12 Agadoo (Dan)	Orange	4	3	Leaf colour green plants vigorous once established
13 Salsa (Dan)	Orange	4	3	Plants not very vigorous, leaf colour dark green reddish
14 Blues (Dan)	Pink	1	1	Plants not very vigorous, leaf colour green
15 Barbados (Dan)	Salmon orange	4	4	Plants moderate vigour with dark green foliage
16 Tobago (Dan)	Mauve/ purple	3	4	Mauve/purple flowers tend to fade, however vigour and overall appearance good with dark green foliage
17 Papete (Dan)	Mauve	5	4	Vigorous variety looks good, leaf colour green

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
18 Helyode (Dan)	Light Mauve with red blush	2	1	Variety although vigorous has a poor appearance leaves dark green
19 Bolero (Dan)	Deep rose/mauve	3	2	Plants not particularly vigorous, leaf colour green
20 Calypso (Dan)	Pink with white eye	3	3	Variety not particularly vigorous, leaf colour green
21 Cha Cha (Dan)	Cherry pink	4		Moderately vigorous variety with green leaf colour
22 Danbee (Dan)	Salmon orange	2	1	Vigorous variety with dark green foliage
23 Lady Hop (Dan)	Rose	3	2	The variety was not vigorous leaf colour green
24 Debka (Dan)	Mauve	4	4	Vigorous variety with light green leaves
25 Delias (Dan)	Pink with red eye	4	2	Moderate vigorous variety with green leaves
26 Samoa (Dan)	White with pink eye	4	2	Moderate under adverse wet conditions, petal formation was prominent leaf colour dark green
27 Selenia (Dan)	Scarlet red	4	4	Moderately vigorous variety with green leaves and a good overall performance

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
28 Marpesia (Dan)	Carmine red	4	5	Vigorous variety with dark green leaves with good overall performance
29 Dunya (Dan)	Dark rose	4	3	Moderately vigorous variety with dark green leaves
30 Strunie (Dan)	Lilac	3	2	Variety moderately vigorous with dark green leaves, did not like wet weather
31 Can Can (Dan)	Orange	3	1	Variety not vigorous under 1993 summer conditions, foliage dark green
32 Tonga (Dan)	Lilac	3	3	Variety moderately vigorous with dark green leaves
33 Tahiti (Dan)	Blush pink	4	4	Variety moderately vigorous with dark green leaves
34 Terinoa (Dan)	Magenta	5	5	Vigorous variety gave a good overall appearance, dark green leaves
35 Antigua (Dan)	Orange	3	3	Moderate vigour, leaf colour green
36 Hailun (Dan)	White to pink	3	2	Moderate vigour, dark green leaves, somewhat untidy

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
37 Hudson (Dan)	Pink	2	2	Moderate vigour with green foliage
38 Hanko (Dan)	Orange	4	3	Vigorous variety with green foliage
39 Aruba (Dan)	Mauve	4	4	Vigorous variety with dark green foliage
40 Maui (Dan)	Orange pink	4	4	Very vigorous variety with only problem being petals falling under wet conditions, foliage dark green
41 Anaea (Dan)	Cherry	4	4	Vigorous variety, leaf colour green generally good
42 Fiji (Dan)	Pale pink	3	3	Moderately vigorous variety which did not appear to stand the adverse weather conditions, green foliage
43 Twist (Dan)	Mauve	4	4	Moderately vigorous variety with green leaves with yellow leaf margin (it may be due to the weather)
45 Ballet (Dan)	White	4	4	Vigorous variety with green leaves
46 Sirtaki (Dan)	Magenta	4	4	Moderately vigorous variety with dark green leaves

Variety	Flower Colour	Flower Performance	Overall Assessment	Comments
46 Bora Bora (Dan)	Lilac	3	2	Moderately vigorous variety with light green leaves, petal form gave adverse appearance under wet conditions
47 Danova (Dan)	Orange blush	3	3	Moderately vigorous variety with dark green leaves

Plant Suppliers (D) = Dummen through Hollyacre Plants Ltd
(Dan) = Danzinger

APPENDIX V

Day Max and Min Temperature and Rainfall July/October 1993

1993	Mean Daily Maximum		Mean Daily Minimum		Total Rainfall	
	1993	L.T. Mean	1993	L.T. Mean	1993	L.T. Mean
July	19.6°C	20.7°C	11.0°C	11.1°C	63.6 mm	45.3 mm
August	19.4°C	20.6°C	9.6°C	11.0°C	45.5 mm	52.0 mm
September	15.7°C	18.1°C	9.5°C	9.1°C	87.2 mm	45.5 mm
October	11.7°C	13.9°C	5.7°C	6.6°C	57.5 mm	43.1 mm

All long term means are for 30 years 1963-1992

Supplied by HRI Kirton

APPENDIX VI

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

PROPOSAL

1. TITLE OF PROJECT **Contract No: PC/80**

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

2. BACKGROUND AND COMMERCIAL OBJECTIVE

The production of New Guinea Impatiens is generally limited to the summer months relying on natural light conditions. To allow the crop to be fully exploited many aspects of its culture need to be examined and schedules produced for plant growth at different times of the year. In particular the potential for the use of supplementary lighting for winter production needs to be assessed.

The crop must be carried through to assess treatment effects on the shelf life properties of the plants. Bud drop during this period is a problem with New Guinea Impatiens and potential treatments to reduce this need to be evaluated.

The varietal response to the chemical and cultural conditions would also need to be examined.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

* Improved quality of final plant.
* Extension of the season for plant production into the winter months.
* Improved shelf life giving quality plants for the retailing and home environment.
* Economic assessments would be made to compare treatments/schedules.
* The treatments improving shelf life may be able to be extrapolated for use on other crops.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

This trial aims to assess the response of a range of varieties to cultural and chemical treatments in successive crops of New Guinea Impatiens. From this comparison treatments with the potential to extend the production season of New Guinea Impatiens, with improved shelf life, may be identified.

5. RELATED WORK

Observations at Lee Valley EHS showed Alar might have potential for use with New Guinea Impatiens in controlling size (Farthing 1984). A small observation trial at Efford carried out by Elaine Sapsed (1990) showed that effects of Alar and Bonzi on New Guinea Impatiens appeared to vary with cultivar.

The results of cultivar trials from Kiel, Germany will soon be available.

6. DESCRIPTION OF THE WORK

Trial 1. To start January 1993.

Lighting treatments

i. 2500 lux supplementary lighting for 12 hours.
ii. 2500 lux supplementary lighting for 18 hours.
iii. GLS incandescent lamps to give long days for 18 hours.
iv. No lighting (control)

Shelf life treatments *

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

i. Untreated control.
ii. Sodium silver thiosulphate.
iii.+iv. Two further treatments with non-silver ethylene inhibiting compounds.

* These treatments may be modified following further discussion with the manufacturers, the project co-ordinator and the HDC.

Varieties

10 to be chosen after discussion.

Culture

DIF drop of 4°C for 2 hours at sunrise.

Design

4 main lighting treatments
x
4 shelf life treatments

16 treatments
x
10 varieties

160 plots in total

Assessments

Time to 50% flowering

At marketing: size score
quality score
bud and flower count

Shelf life: flowering assessments
bud drop assessments
final quality score

Photographs at all stages as appropriate.

Trial 2. To start May 1993.

This trial would draw on data from the January trial, allowing the more promising treatments to be followed up, especially in relation to shelf life. Lighting would be less applicable at this time of year allowing other cultural factors such as plant growth regulators, temperature, nutrition and shading to be examined.

Shelf life in this trial may be in bedding out and/or patio facilities.

Commercial trialling

To be carried out at two nurseries.

The ten varieties grown at Efford would be grown at the nurseries along with a range of other varieties. The plants would be grown under the standard culture conditions appropriate to each nursery. The use of the DIF 4°C drop for two hours at sunrise and application of plant growth regulators as required would be common to all sites.

7. COMMENCEMENT DATE AND DURATION

Start date: 01.01.93; duration 8 months.

First trial to commence: January 1993, second May 1993.

8. STAFF RESPONSIBILITIES

Trials officers: Dr E Attfield/Mr L Sach - HRI Efford
Mr H Kitchener - ADAS for Commercial trialling

HDC Co-ordinator: Mr Steve Morely

9. LOCATION

Main Trial: HRI Efford

Commercial Trials: S Morely, Raceground Nursery, Spalding
Hill Brothers, Chichester

Additional bedding out sites: Springfields, Spalding
University of Plymouth, Bere Alston

Contract No: PC/80

TERMS AND CONDITIONS

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

Signed for the Contractor(s)

Signature.....

Position..Commercial and Marketing Manager HRI

Date.....18/3/93.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position.....CHIEF EXECUTIVE

Date.....20.1.93.....