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1 Practical Section for Growers

1.1 *Background & Objectives*

This report summarises the findings of a three year project (PC155) to reduce the number of PGR applications needed to control height in poinsettia and to improve the graphical tracking system used in this country.

The pot plant industry relies on high inputs of plant growth regulators (PGRs) to ensure that the product meets rigorous height specifications set by the multiples. Multiples require their growers to comply with quality assurance schemes which aim, amongst other things, to reduce the inputs of pesticides (this includes PGRs) on products entering the marketing chain. The costs of applying PGRs can be high, due in the main to labour costs, especially when the number of applications may exceed 20. Temperature manipulation (DIF) has been developed as a cultural technique to assist with height reduction. Data from years 1 and 2 of the project demonstrated that DROP consistently reduced poinsettia height, but is not sufficient to produce marketable plants alone. The 2 years of treatment have demonstrated that chemical PGRs used in conjunction with DROP appear more effective, with up to 35% lower inputs of Cycocel required to achieve the required height specification. In addition, further reductions were obtained by using stronger-acting Bonzi and Alar/Cycocel mixes without compromising plant quality or post-harvest performance.

Previous seasons have demonstrated some of the difficulties UK growers have using a graphical tracking system developed in the USA (UNH Floratrack). The main problem appears to be that the track was developed in areas with relatively high and stable light conditions throughout production (beginning, in the case of Michigan, with 23% more light in week 32 and ending with 95% more light). The UNH track assumes a more rapid growth rate after pinching than is typically seen in crops grown at Efford, and also assumes that extension growth ends well before harvest, whilst Efford crops tend to elongate right up to harvest. This project aims to develop a new graphical track for the UK that reflects observed growth characteristics of poinsettias grown under UK conditions and so optimizes PGR use.

The final year's trials aimed to confirm the effective use of a variety of PGRs in combination with DROP to reduce the PGR inputs to a poinsettia crop and provide data for the development and production of a UK track.

1.2 ***Summary of Results***

Effect / Result	Year 1	Year 2	Year 3
4 weeks after potting			
Height	No difference	Sonora taller	No difference
Breaks	Sonora 6.8, Spotlight 6.1	Sonora 5.8, Spotlight 5.4	Sonora 6.5
Uniformity	No difference	No difference	No difference
Effect of DROP			
Sharpening of response to short days	Yes	Yes	No
Advances crop colour and flowering	Yes	Yes	No (Yes for Spotlight)
Shortens plant height	No	Yes	No
Sufficient to replace PGRs	No	No	No
Improves PGR response	Yes	Yes	Yes
Reduces overall PGR use	Yes	No	Yes
Effect of PGR			
More uniform crop	Yes	Yes	Yes
Fewer applications required using Bonzi and Alar	Yes	Yes	Yes
Marketing			
DROP reduced plant spread	Yes	Yes	No
DROP gave paler bracts	Yes	No	No
DROP reduced cyathia number and maturity	Yes	No	No
PGR reduced plant spread	Yes	Yes	Yes
PGR increase secondary growth	Yes	Yes	No
PGR reduce bract size	Yes	Spotlight yes, Sonora no	Yes
Shelf Life			
PGR increased green leaf loss	Yes	Yes (ccc lowest)	Yes ‡
Bonzi increased cyathia loss	Yes	Only in first week	First week ‡
DROP reduced green leaf loss overall	Yes	Yes, but not at de-sleeve	Yes ‡
DROP lowered necrosis and paling	Yes	Yes, but not consistently	No ‡
DROP reduced bract loss	Yes	No (only Sonora)	Yes ‡
DROP increased cyathia loss	Yes	No (only Spotlight)	No ‡
Bracts pale	Yes	DROP paled slower	Yes ‡
Sonora lost more leaf than Spotlight	Yes	Yes	N/A
Sonora kept cyathia longer	Yes	Yes	N/A

‡ Note: Caution is required with year 3 shelf life results as Botrytis was a problem

1.3 *Action points for Growers*

- Use DROP as part of normal crop management; it reduces PGR use and often improves shelf life of poinsettia.
- On the south coast of the UK, it may be necessary to fix a DROP set point of 8^{o}C in order to achieve a DROP of at least 3 to 4^{o}C. Growers in the North of the country need to be more cautious as lower ambient temperatures will prevail.
- The use of DROP at initiation should improve the evenness of short day response.
- The use of stronger acting PGRs, especially Bonzi, early in production will reduce total PGR applications, and evidence suggests that early (post pinching) sprays improve shelf life.
- Poinsettia Tracker^{TM} V1.0 has been designed as a height management tool to fit the growth of poinsettia in the UK. Growers should use Poinsettia Tracker^{TM} alongside existing growth curves until its value is confirmed and thereafter develop more accurate height management tracks for their crops. Please contact the HDC office if you wish to obtain a copy of Poinsettia Tracker™.

1.4 *Practical and anticipated financial benefits*

The use of DROP and stronger acting PGRs will reduce the number of PGR applications required to produce a poinsettia crop. The benefit of reduced applications is in reduced labour costs, reduced exposure to chemicals and meeting multiple QA schemes. Unfortunately the additional costs of the stronger acting PGRs can at first appear to mitigate any financial benefits. The final benefit will combine meeting multiple specifications, reduced labour cost, and reduced chemical use, these will ensure that UK growers maintain their competitive position in the market.

2. Science Section

2.1 *Introduction*

The pot plant industry relies on high inputs of plant growth regulators (PGRs) to ensure that the product meets rigorous height specifications set by the multiples. Multiples require their growers to comply with quality assurance schemes which aim, amongst other things, to reduce the inputs of pesticides (this includes PGRs) on products entering the marketing chain. In addition to quality assurance schemes, there is also increasing pressure from the multiples for product guarantees that can be reliably offered to consumers. There is also the possibility that PGRs may be withdrawn from the list of approved chemicals, and alternative strategies need to be researched in good time.

The costs of applying PGRs can be high, due in the main to labour costs, especially when the number of applications may exceed 20. Temperature manipulation (DIF) has been developed as a cultural technique to assist with height reduction. Data from the first year of this project indicated that DROP (a reduction in temperature during the first hours of the day) was insufficient on its own to control poinsettia height to market specifications. However, years 1 and 2 of the project did demonstrate that DROP consistently reduced poinsettia height by approximately 2cm, although this was only significant in year 2. DROP has been shown to work well in situations where temperatures outside are low and light levels are high, as in some of the U.S. poinsettia production areas. The U.K. growing environment is usually warm outside early in production, when light levels are highest, and growth is strongest, and these conditions do not favour the use of DROP. However, the 2 years of treatment have demonstrated that chemical PGRs used in conjunction with DROP, appear more effective, with up to 35% lower inputs of Cycocel required to achieve the required height specification. In addition, further reductions were obtained by using stronger-acting Bonzi and Alar/Cycocel mixes without compromising plant quality or post-harvest performance.

In the first year it was demonstrated that the Alar/Cycocel mix was more powerful in controlling plant height than Cycocel alone. In the second year of study Alar was applied alone to demonstrate whether the effects of these chemicals are additive or synergistic when combined. It was shown that the effects were simply additive, with Cycocel having an immediate effect and Alar a slightly longer term effect. The popular belief within the industry was that Alar was ineffective in controlling poinsettia height when used on its own, but this is not the case. Alar has a longer term influence than Cycocel and acts, therefore, more like Bonzi.

The 1998-99 season also demonstrated some of the difficulties UK growers have using a graphical tracking system developed in the USA (UNH Floratrack). The main problem appears to be that the track was developed in areas with relatively high and stable light conditions throughout production (beginning, in the case of Michigan, with 23% more light in week 32 and ending with 95% more light). The UNH track assumes a more rapid growth rate after pinching than is typically seen in crops grown at Efford, and also assumes that extension growth ends well before harvest, whilst Efford crops tend to elongate right up to harvest. This project aims to develop a new graphical track for the UK that reflects observed growth characteristics of poinsettias grown under UK conditions and so optimizes PGR use.

The final year's trials in 2000/2001 aimed to confirm the effective use of a variety of PGRs in combination with DROP to reduce the PGR inputs to a poinsettia crop and provide data for the development and production of a UK track.

2.2 *Objectives*

(i) Further investigate the comparison of standard cycocel treatments with stronger acting plant growth regulators for height control in natural season poinsettia crops.
(ii) Provide evidence from a third season to determine the interaction between PGR efficiency and DROP.
(iii) Investigate the effects of the production treatments on post-harvest performance.
(iv) Consider the potential cost-effectiveness of each PGR strategy in terms of chemical and labour costs and ease of implementation.
(v) Provide data for the development of a height control management tool to be used in the UK, which would reduce PGR use and maximise post harvest quality.

2.3 *Materials and Methods*

A split plot experiment examined the interaction between various PGR treatments and DROP. This meant the main effect of DROP was unreplicated (as only 2 compartments were used) and the effects of each PGR treatment were replicated twice in each compartment (North replicate and South replicate). ANOVA was used to identify main temperature treatment effects (DROP versus STANDARD TEMPERATURE), effects of PGR treatments and any interactions between temperature and PGR treatments. The effects of all treatments were considered at marketing and each week during shelf life. This experiment used a single variety of poinsettia 'Sonora' as this is one of the most

commonly grown varieties in the UK. A second trial was also ran using two other important commercial varieties 'Spotlight' and 'Freedom' to assess how DROP interacts with 2 specific PGR treatments in these varieties. Irrigation was by hand via capillary matting.

Experiment 1

Main treatments

Temperature (2 treatments)

- Standard commercial temperatures.
- Extreme DROP, with a DROP set-point of 8ºC for 3 hours after dawn.

Plant Growth Regulators (8 treatments)

- **C -** Cycocel, commercial standard and control
- **B -** Bonzi, used during production, until short days followed by Cycocel
- **A -** Alar / Cycocel mix, used during production, until short days followed by Cycocel
- **BB** – Bonzi used throughout production, especially late in production
- **AA –** Alar / Cycocel mix used throughout production, especially late in production
- **U –** Unregulated by PGR's, to show the effects of DROP alone on height
- **EC –** Early Cycocel, applied after pinch, before track height reached, followed by Cycocel
- **EB –** Early Bonzi, applied after pinch, before track height reached, followed by Cycocel

Experimental design

Two compartments in Q block were used, each running a single temperature treatment. Each compartment contained 12 benches, 4 on the North side, 4 on the South and 4 in the middle. Each bench held 2 experimental plots of 50 plants at final spacing ($9m^{-2}$), therefore each of the 8 PGR treatments were repeated in the North and South of each compartment. The experimental design was thus:

2 temperatures x 8 PGR treatments x 2 replicates = 32 plots

Experiment 2

The second experiment used two widely used commercial varieties 'Spotlight' and 'Freedom' grown in the temperature regimes of the main trial and treated with either cycocel (**C** - commercial control) or bonzi throughout production (**BB** - most persistent and strongest PGR). The experimental design was thus:

2 varieties x 2 temperatures x 2 PGR treatments x 2 replicates = 16 plots

During production each treatment plot was monitored using the UNH Floratrack graphical tracking system for poinsettia. Each week the height of 10 pots per plot were measured and plotted against the standard curve in the UNH Floratrack package. If the actual measured growth for a given week either exceeded the track height or the growth in a given week was higher than predicted for that week, then plant growth regulator was applied.

Production

Rooted cuttings were received and potted in week 31 of year 2000 into 13cm terracotta plastic pots filled with Sinclair poinsettia compost. Plants were grown pot thick until the leaves began to touch, at which time they were spaced for the first time. Spacing occurred on two further occasions so that the final pot density was 9 pots m^{-2}. So that treatment differences were easier to interpret, time of spacing was standardised across all treatments for each variety.

Immediately after potting, plants were fleeced for a week to aid early establishment. During the first 3 weeks screens were used to shade the crop when external light levels exceeded 300 Wm^{-2}, increasing to 400 Wm^{-2} in week 2 and 550 Wm^{-2} in the third week. After this all plants received ambient light levels until 1st September 2000 at which point day length extension lighting was provided (six 400W SON-T's per compartment) from 04.40h to 07.20h until 20th September, after which short days were maintained by screening the crop in order not to delay flowering.

Poinsettia nutrition was adjusted regularly in order to respond to the growth requirements of the plants as they grew. The feed was applied to all treatments as standard so that perceived differences were due to treatments not feed. The 4 feed mixes used were:

(i) Start: wks 31-34: $CaNO_3$ (125 ppm N; pH 6.0; ec 0.7 + background)

(ii) Early: wks 34-40: Early season feed (225 ppm N, 40 ppm P, 175 ppm K, 40 ppm Mg + liberal BMX 10gl^{-1} @ 1:100, Ca EDTA 10gl^{-1} @ 1:100)

(iii) Main: wks 41-43: Main season feed (175 ppm N, 40 ppm P, 175 ppm K, 40 ppm Mg + liberal BMX 10gl^{-1} @ 1:100, Ca EDTA 10gl^{-1} @ 1:100)

(iv) Late: wks 44 –end: Late season feed (140 ppm N, 50 ppm P, 180 ppm K, 50 ppm Mg + liberal BMX 10gl^{-1} @ 1:100, Ca EDTA 10gl^{-1} @ 1:100)

Pest and disease control was achieved using an integrated crop management approach. At potting sciarid larvae were controlled with a Nemolt drench, after which monthly introductions were made of *Hypoaspis miles*. Potential whitefly were controlled with *Encarsia formosa* introduced weekly until week 45.

Experimental records

During production

- Plant height - cm (weekly for graphical track data)
- Number of breaks (after 4 weeks)
- Quality / uniformity (after 4 weeks)
- Date of first colour per pot
- Date of first visible cyathia per pot
- Plant height - cm (from bench to top of foliage)
- Plant diameter - cm (across widest point and at 90 degrees)
- Number of breaks on each plant
- Number of heads on each plant within each of four size grades:
  - Size grade (i) < 150 mm
  - Size grade (ii) 150 – 200 mm
  - Size grade (iii) 200 – 225 mm
  - Size grade (iv) > 225 mm
- Size (length & max. width) of largest red leaf or bract per plant - mm.
- Bract colour using RHS colour cards: to be carried out in a uniform light environment (plus notes relating to any bract disorders)
- Cyathia number (dominant break)
- Cyathia stage of development (dominant break)
  - Stage 1 = tight green bud
  - Stage 2 = bud colour
  - Stage 3 = pollen showing
  - Stage 4 = stigma open
  - Stage 5 = pollen and stigma
- Score of overall quality
  - 0 = Unmarketable (few uneven heads)
  - 1 = Second Grade (3 – 4 heads above canopy)
  - 2 = First Grade (5-6 coloured heads at canopy height)

Environmental analysis

- Media analysis, at potting and at 2 weekly intervals thereafter
- Liquid feed analysis, 2 weekly from potting to marketing
- Temperature logging to record DROP achieved
- External light level ($MJ/m^2/day$)

- Compartment temperature (D/N/24h avg)
- Compartment relative humidity (D / N / 24h avg)
- Compartment CO_2 concentrations
- External day and night temperatures

During Shelf Life

- Number of leaves on the tagged break
- Cyathia number and stage of development (tagged break)
- Leaf loss per plant
- Red bract loss per plant
- Incidence of bract necrosis, rabbit tracking
- Incidence of *Botrytis* on leaves and bracts
- Mechanical damage score:
  - 0 = none
  - 1 = slight
  - 3= moderate
  - 5 = severe
- Leaf colour score for upper and lower canopy foliage:
  - 0 = dark green
  - 1 = slight paling
  - 3= moderate paling
  - 5= severe yellowing
- Bract colour
- Plant longevity: determined as time up to which plant would be fit to remain on display

Statistical analysis

The data were analysed using standard ANOVA. Data that needed transformation were square root transformed, which means that the standard errors and least significant differences from the analysis DO NOT relate to the actual numbers from the treatments. In these circumstances the F value from the analysis and the probability of the result being chance will also be cited in the results.

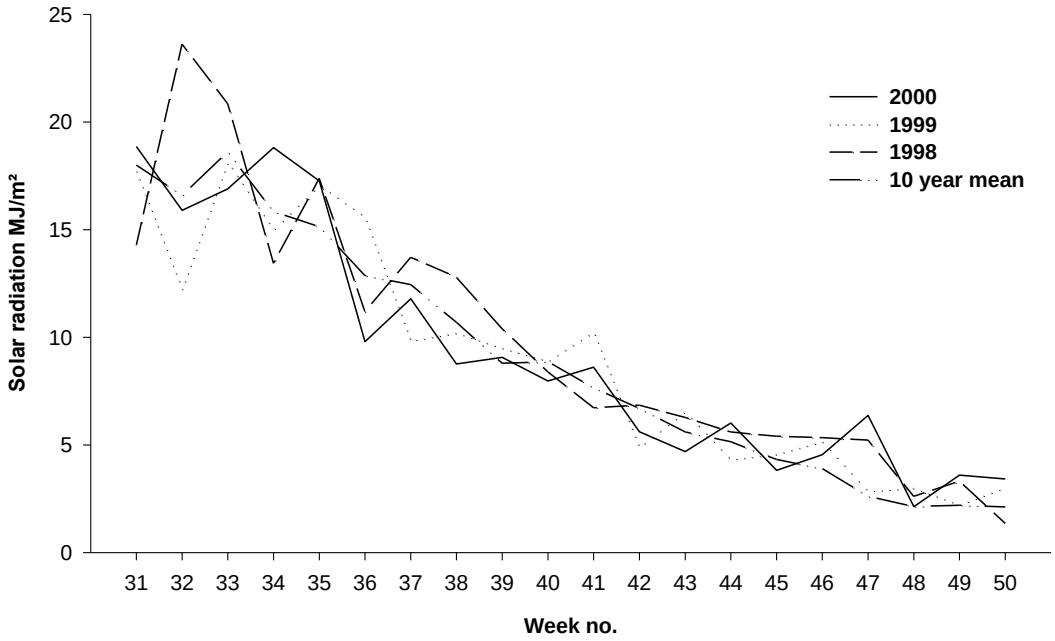
2.4. *Results and Discussion*

The results are presented as the effects of main treatments, i.e. temperature effects and PGR effects. When an interaction occurred it is refereed to as an exception. The two experiments are dealt with separately.

Environmental data

The light receipt in 2000 was very similar to the previous two years (Fig 1) and not significantly different from the long term mean. The poor light between weeks 35 and 39 meant that the growth in those weeks was less than one would expect, but did not adversely effect the overall growth over the season.

Figure 1: The solar radiation (MJ/m$^{2/}$day) received for poinsettia production from 3 trial seasons compared to the 10 year average.



The 24 hour average temperature in each compartment declined as expected over the production period from 24°C in week 31 to 16°C in week 50 (see Fig 2). The achieved DROP was 3°C on average, while the maximum DROP was often 4.5°C (greatest was 7.6°C) (see Fig 3). This method of setting much lower set points to achieve a reasonable DROP has been used successfully at Efford for the past two years but would need modification in more Northern areas as achieving a DROP there would be easier than on the South coast.

Figure 2: Average 24 hour temperatures achieved in temperature treatments in 2000.

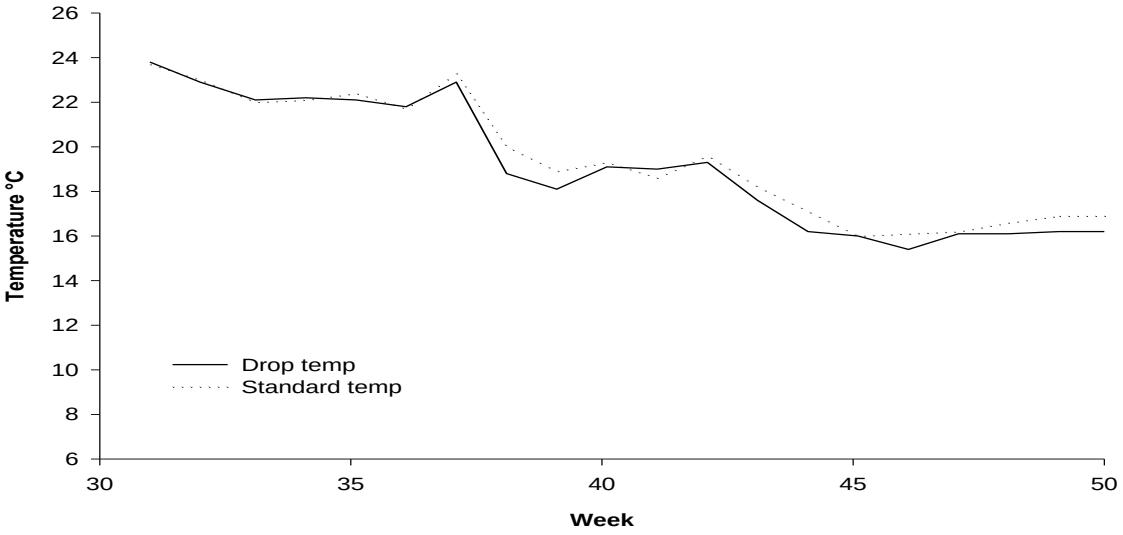
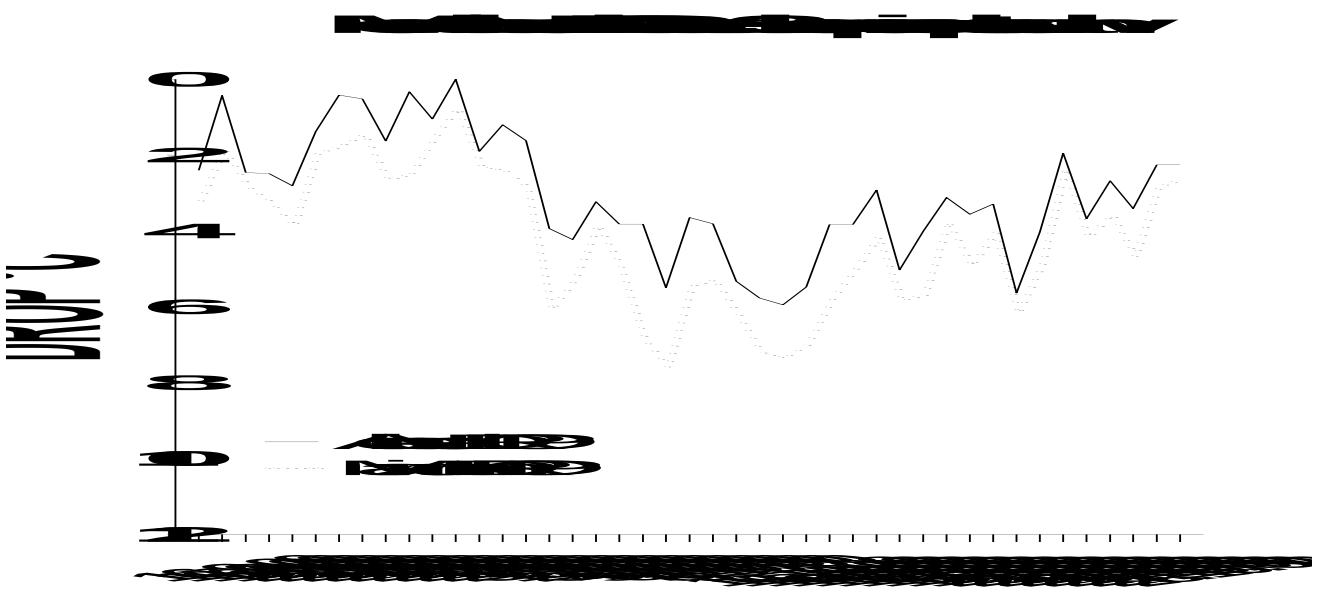


Figure 3: The average achieved DROP and the maximum DROP achieved in 2000.



Data 4 weeks after potting

These records were taken early in the trial after the plants had been pinched and as the earliest treatments were started. They confirm that there were no pre-treatment differences. As the main experiment only used one variety this year there were no differences between treatments; there were slight differences between varieties in experiment 2 with Spotlight having the same number of breaks as Freedom in a plant 1cm shorter.

Experiment 1

Production

The number of applications of PGR's required to achieve a marketable poinsettia was reduced by up to 34 % by using DROP (Table 1). However, DROP alone was not sufficient to restrict the height of a poinsettia to a marketable height, but did reduce the height consistently by 2 cm as in years 1 and 2 (this was significant in year 2 but not in years 1 and 3).

Table 1: The number of PGR applications for each treatment in standard and DROP temperature regimes and the % reduction in applications due to DROP (see page 6 for details of PGR treatments)

Treatment	Standard		DROP		% reduction in number of applications of PGRs
	Main trt	Additional CCC	Main trt	Additional CCC	
C	23		16		30.4
EC	24		18		25.0
A	8.5	10.5	8.5	4	34.2
AA	16.5		13		21.2
EB	2	7	2	7	0
B	1	6	1	6	0
BB	2.5	6	2.5	6	0

The use of Bonzi reduced the number of PGR applications made to the crop (by up to 70%) (Table 2) but, the number of applications of Bonzi required for growth control was not affected by temperature treatment. This was also observed in year 2.

Table 2: The reduction in PGR applications compared to commercial cycocel control (see page 6 for details of PGR treatments)

Treatment	Standard		DROP	
	Total applications	% Reduction	Total applications	% Reduction
C	23		16	
EC	24	+4.3	18	+12.5
A	19	17.4	12.5	21.9
AA	16.5	28.3	13	18.8
EB	9	60.9	9	43.8
B	7	69.6	7	56.3
BB	8.5	63.0	8.5	46.9

Marketing

The number of days taken to first colour was not affected by DROP. This has been the case for Sonora in previous years. However, Spotlight does tend to colour earlier with the use of DROP (see experiment 2). As in previous years the application of PGRs reduced the number of days to first colour but never by more than 2 or 3 days, and within the PGR treatments, Bonzi treated plants coloured 1 day earlier than cycocel treated plants. Alar plants coloured one day later than cycocel plants. At present plants cannot be produced in the complete absence of PGR's so the ±1 day difference is not significant. The effect on first visible cyathia was exactly the same with a difference of only ±1 day between all PGR treatments.

PGRs had to be used to achieve marketable height with unregulated plants being about 10 cm above maximum specified height (Fig 4). All PGR treatments except the cycocel control gave heights within the specified range; cycocel plants averaged about 1 cm above maximum target height despite up to 23 applications. The early PGR treatments gave the shortest plants (Fig 4). The spread of poinsettia was

not significantly reduced by DROP although these plants tended to be narrower. An exception to this was the bonzi treated plants that tended to have an increased spread in the DROP treatment. Overall, alar / cycocel treated plants gave the smallest spread, but the difference from unregulated plants was only 3cm and all plants were well over the minimum supermarket specification of 38cm (Fig 5).

Figure 4: The mean height of Sonora plants grown in the different PGR treatments (averaged over temperature treatments). The shaded area gives the current UK supermarket specification range **(see page 6 for details of PGR treatments).**

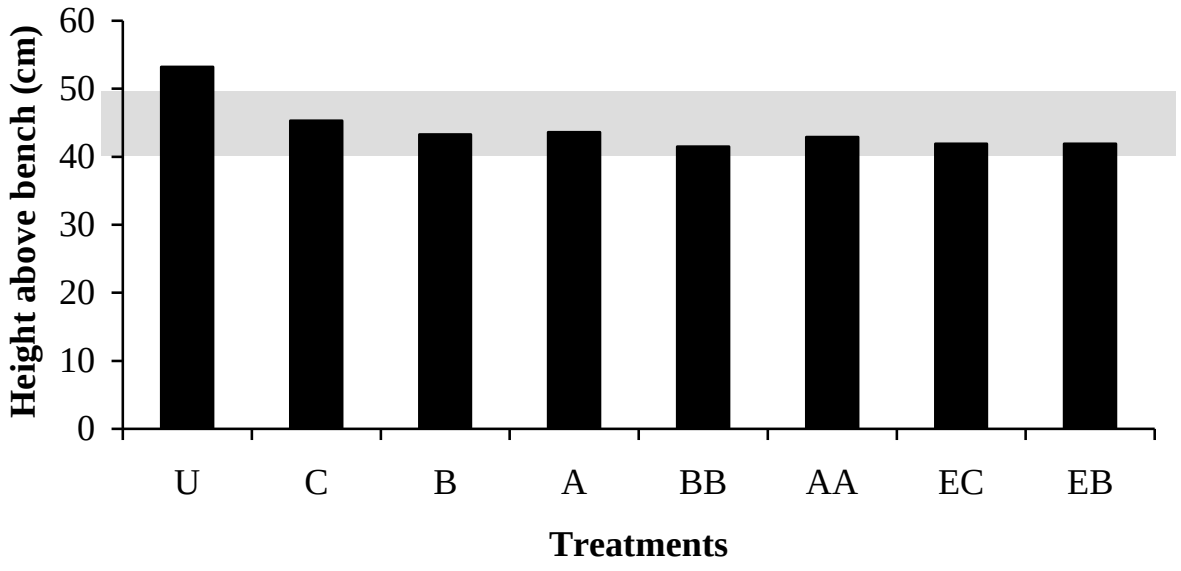
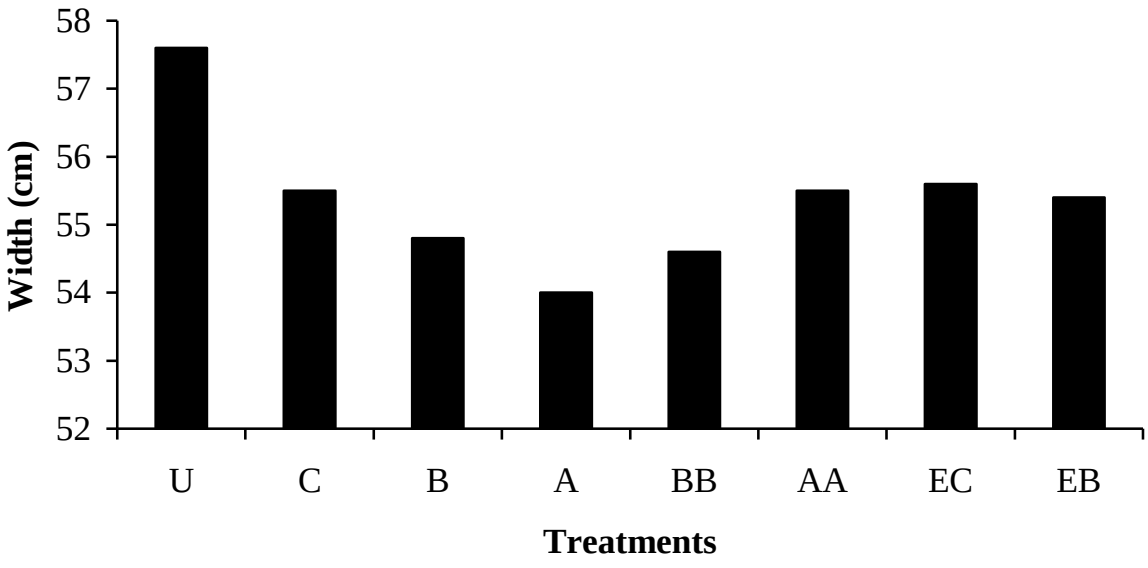
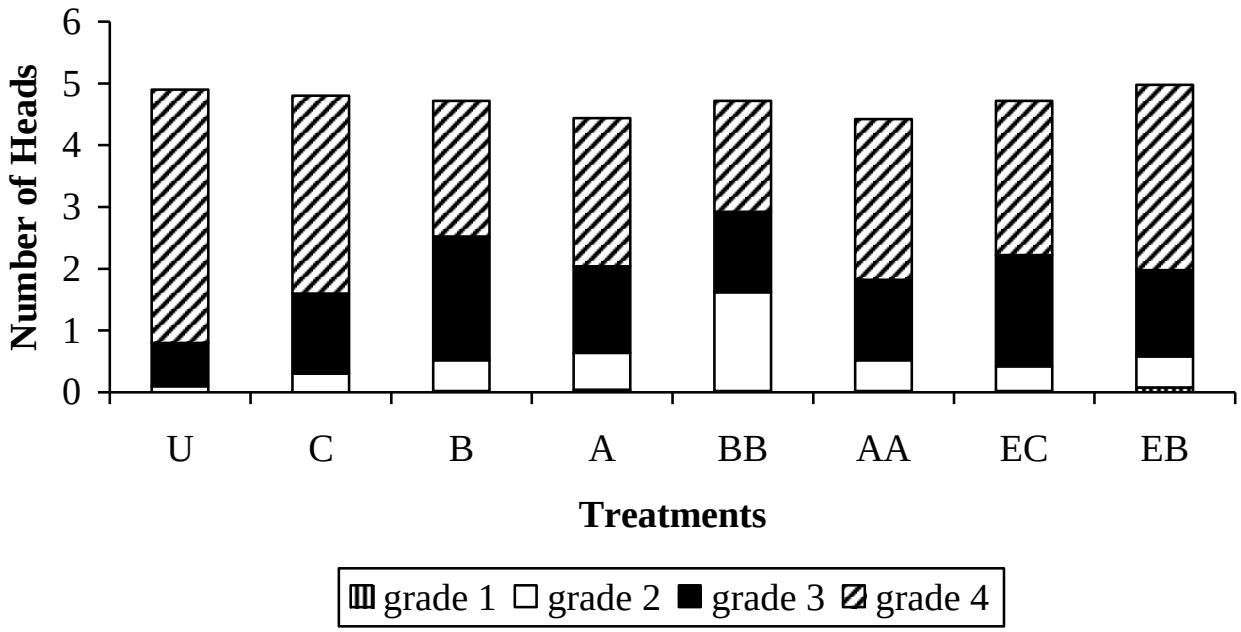


Figure 5: The mean width of Sonora plants grown in the different PGR treatments (averaged over temperature treatments) (Please see page 6 for details of PGR treatments).



The mean number of primary heads on all plants was 4.7 and there was no significant effect of either temperature or PGR treatment. There was also no effect of treatment on the number of secondary heads, with the overall average being 1.5 heads. However when the size categories of primary heads were considered, all PGRs reduced the number of heads classed as size grade 4 (the largest) and increased the grade 3 bracts. No specification on bract size exists, but growers do not tend to like over large bracts that cover the foliage. The only significant effect within the PGR treatments was that the late application of Bonzi after colour was showing, reduced the numbers of grade 3 and increased the numbers of grade 2 bracts (Fig 6). This late application of bonzi to the foliage confirms growers' concerns that bonzi on the bracts can reduce or delay their development.

Figure 6: The number of heads in each size category for the main PGR treatments (averaged over temperature treatments). (See page 6 for details of PGR treatments).



In the first year of the experiment, DROP was noted to give paler bracts, but this was not true for years two or three. In fact the difference in bract colour between treatments was negligible. Foliage colour was also not effected by either DROP or PGR treatments. Again in year one DROP reduced the number of cyathia on a break, but in years 2 and 3 there were no differences in cyathia number. In the 2000 trial the average cyathia number was 9.5 on each break and this varied as much on a single plant as between treatments. Finally the overall quality score given to the treatments only found the unregulated plants to be of significantly poorer quality compared to all other treatments. The mean quality score for all plants other than unregulated plants was 1.8 (2 was the best quality).

Shelf-life

All the poinsettias from experiment 1 were kept in the same shelf life room for the 6 weeks of shelf life. During the first 2 weeks a problem occurred with the shelf life facility and control of humidity was lost. This meant that humidity levels rose to 100% on several occasions, leading to increased disease levels, specifically of *Botrytis*, which damaged most of the plants. In previous years trials there has been essentially no disease, so this level of disease is extraordinary and effects all shelf life records. However, the disease pressure was constant for all treatment plants and as such offers an insight into which PGR treatment (if any) offers robust plants in extreme conditions.

The main criteria judged in shelf life assessments are bract, leaf and cyathia loss. These were analysed both on each sample occasion and as a cumulative total. This allows comment to be made not just on whether more or less are lost in a given week but also overall. Interestingly in the absence of PGRs DROP treated plants retained more leaves and bracts; however when combined with PGRs this beneficial effect is lost in Sonora, as all PGR treatments cause an increase in bract and leaf loss compared to the unregulated control. This means in most commercial situations the only advantages of DROP with Sonora are in production rather than in shelf life. When one considers cumulative leaf and bract loss the only significant effect was that the unregulated plants lost fewer leaves and bracts (Fig 7&8). On a weekly basis it was the cycocel and alar treated plants that lost most leaves and bracts.

The number of leaves lost by Sonora was similar to that in previous years trials. However the bract loss was much increased as a result of the increased incidence of *Botrytis*. The loss of cyathia was even more affected by *Botrytis* and most cyathia were lost by 1 week into shelf life and so no treatment differences could be detected. Sonora usually keeps 20% of cyathia throughout shelf life, so the pressure of disease can be seen as very damaging in this regard.

Figure 7: The cumulative leaf drop for Sonora under the main PGR treatments. (Please see page 6 for details of PGR treatments).

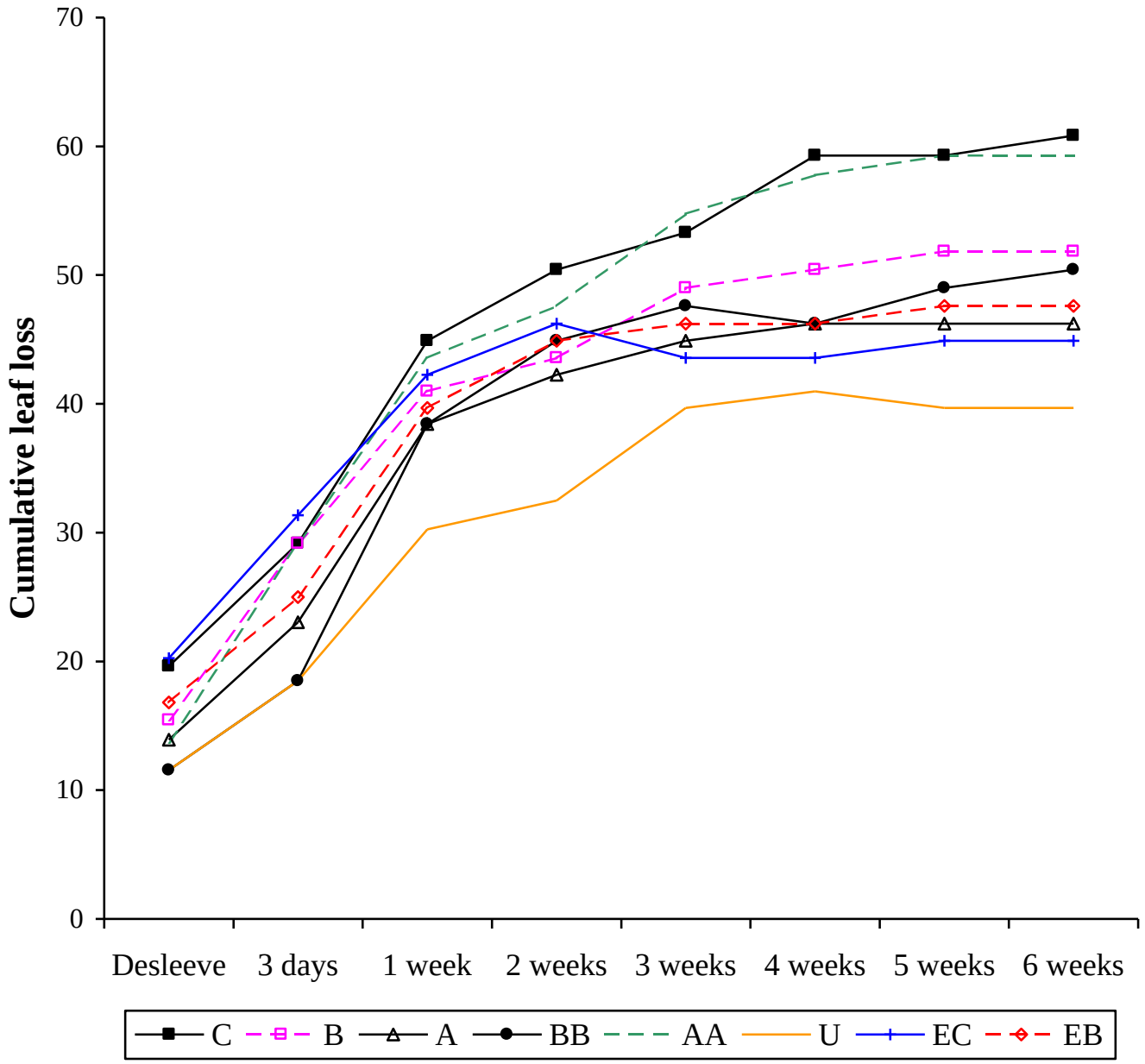
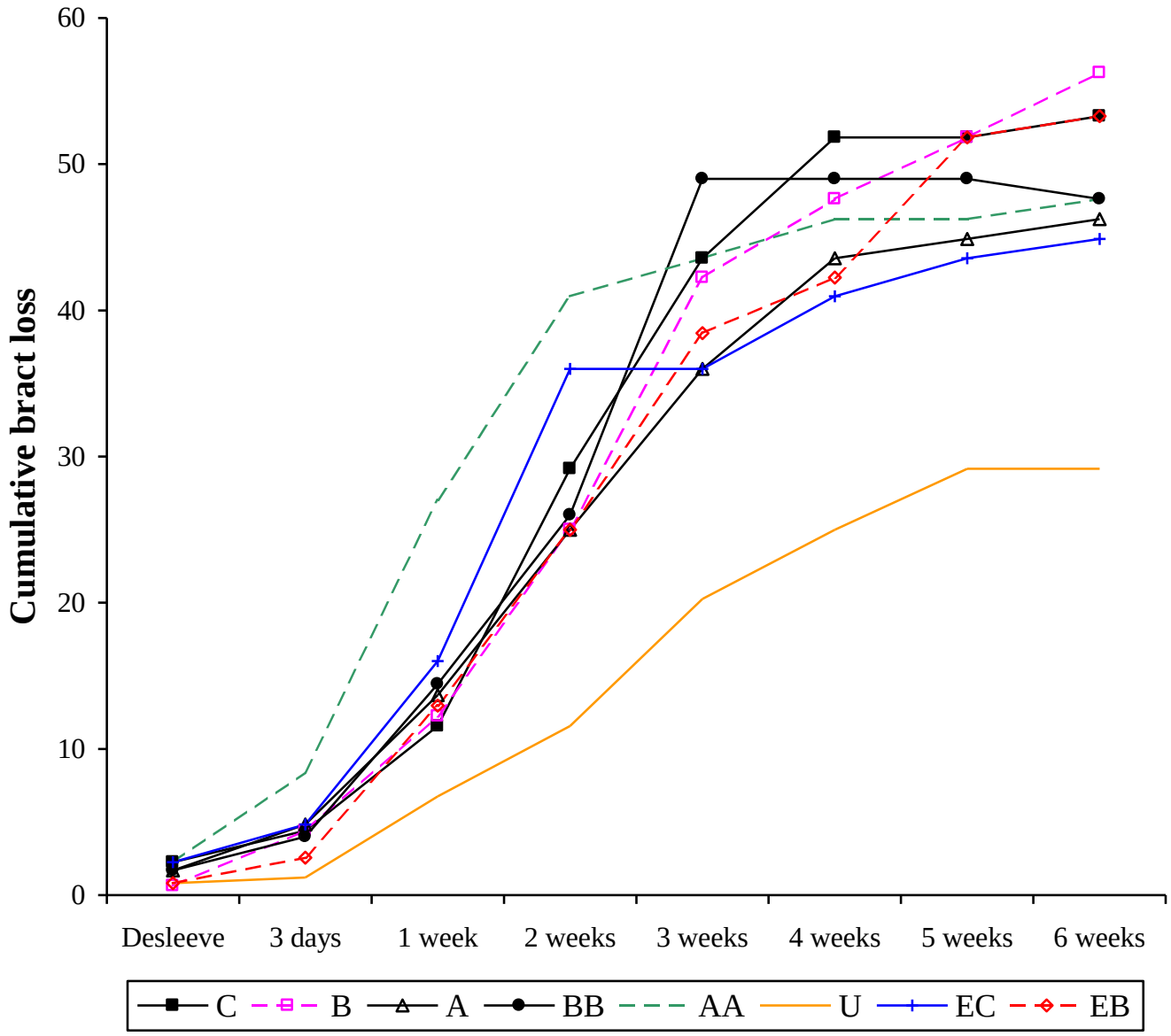


Figure 8: The cumulative bract drop for Sonora under the main PGR treatments. (Please see page 6 for details of PGR treatments).



Experiment 2

Marketing

The demonstration experiment with Spotlight and Freedom demonstrated that both varieties showed advanced colour and cyathia development in the DROP treatment. Both varieties showed colour and cyathia one to three days sooner under DROP. Similarly colour was advanced by one day when bonzi was used during production. The effects of DROP were limited to advancing the crop and had no significant effects on other marketing traits.

Poinsettia height was significantly reduced by the application of bonzi during production. Freedom was reduced by 2cm but Spotlight was reduced by 6cm compared to plants grown with cycocel only (Fig 9). As with the Sonora plants the cycocel only treated plants were actually just taller than market specification, showing that strong acting PGRs used early in production can not only reduce applications but also assist in the management of the crop. The width of the poinsettia was also reduced by the stronger action of bonzi (Fig 10); but the varietal difference was more noticeable, with Spotlight being a much wider plant and more affected by bonzi.

Figure 9: The mean height of poinsettia varieties under 2 PGR treatments. Shaded area shows market specification.

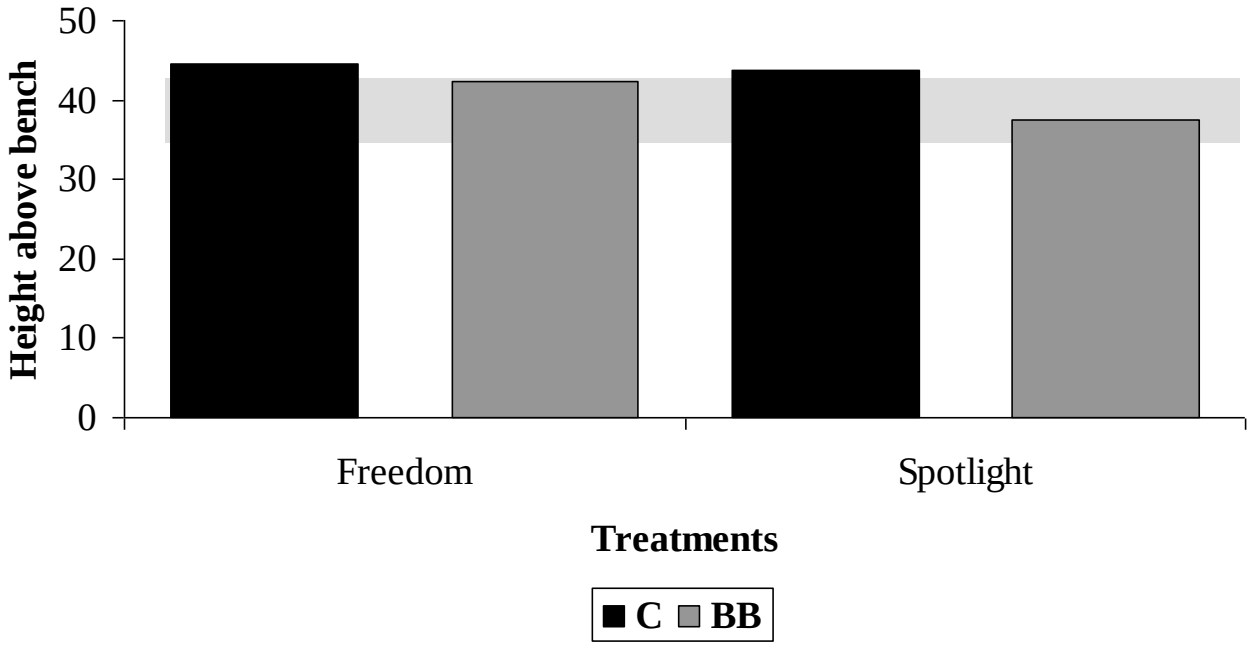
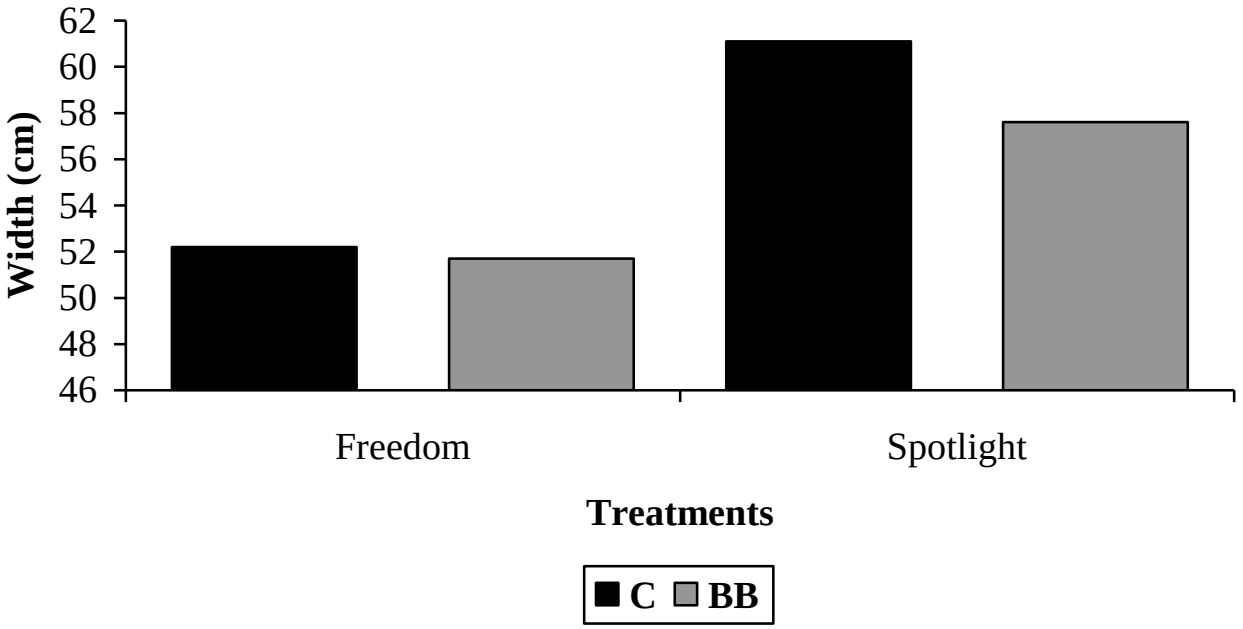
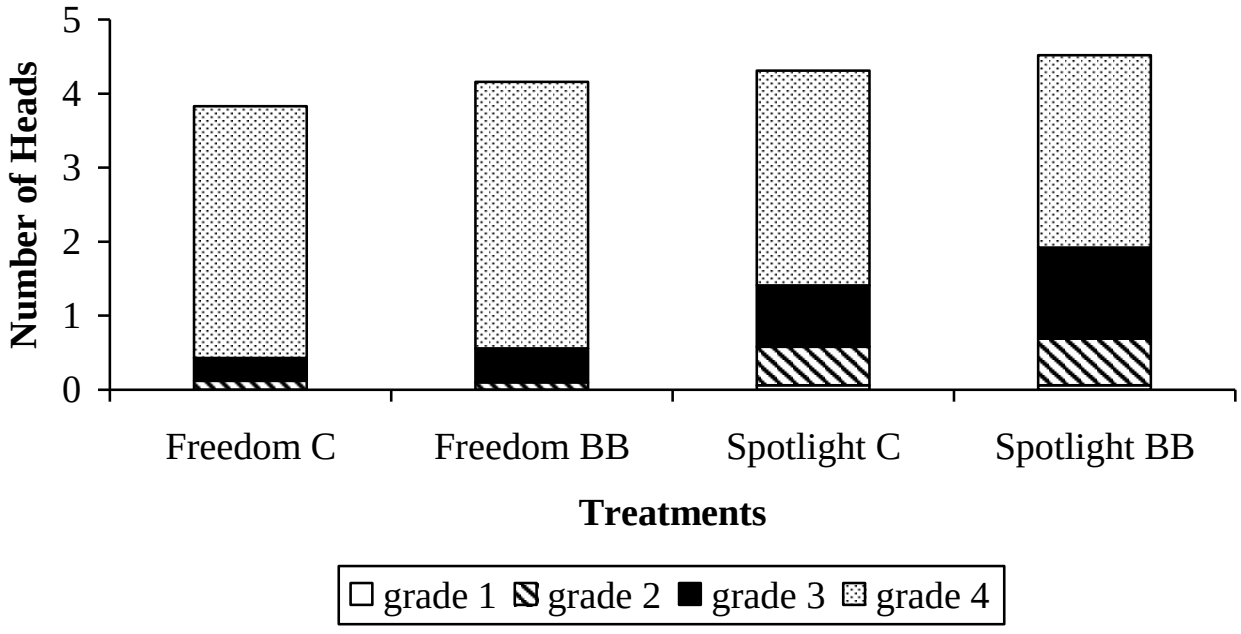


Figure 10: The mean width of poinsettia varieties under 2 PGR treatments.



The use of bonzi increased the number of primary heads slightly in both varieties, but not significantly, although the varieties themselves were different with Spotlight having more primary heads (Fig 11). There was no significant difference in the number of secondary heads either between varieties or treatments, although bonzi treated plants had slightly more.

Figure 11: The number of heads in each size category for the main treatments.



The remaining variables recorded at marketing demonstrate that the varietal differences were greater than any differences due to either temperature or PGR. Spotlight tends to have darker foliage and more cyathia. When quality was considered Freedom and Spotlight had a very similar average score, although Freedom's score was increased by the application of Bonzi, from 1.5 to 1.8, where Spotlight's was reduced from 1.6 to 1.4.

Shelf life

Unlike Sonora the greatest treatment effect on Spotlight and Freedom in shelf life was temperature treatment. Essentially both PGR treatments behaved in a similar way, and the largest difference was varietal. However, the effect of DROP was to improve the shelf life of both varieties by reducing the numbers of leaves and bracts lost. The reduction in leaf drop in Spotlight and Freedom was quite dramatic (Fig 12) with Spotlight loosing half the number of leaves on plants grown in a DROP regime compared with a standard temperature regime. The bract loss was lower for DROP grown plants of Freedom early in shelf life but the differences became non significant by the end of 6 weeks. Bract loss for Spotlight was reduced by over 60% from the point of de-sleeving for plants produced under a DROP regime compared to a standard temperature regime. (Figure 13).

Figure 12: The cumulative leaf drop for Freedom and Spotlight under the main temperature treatment.

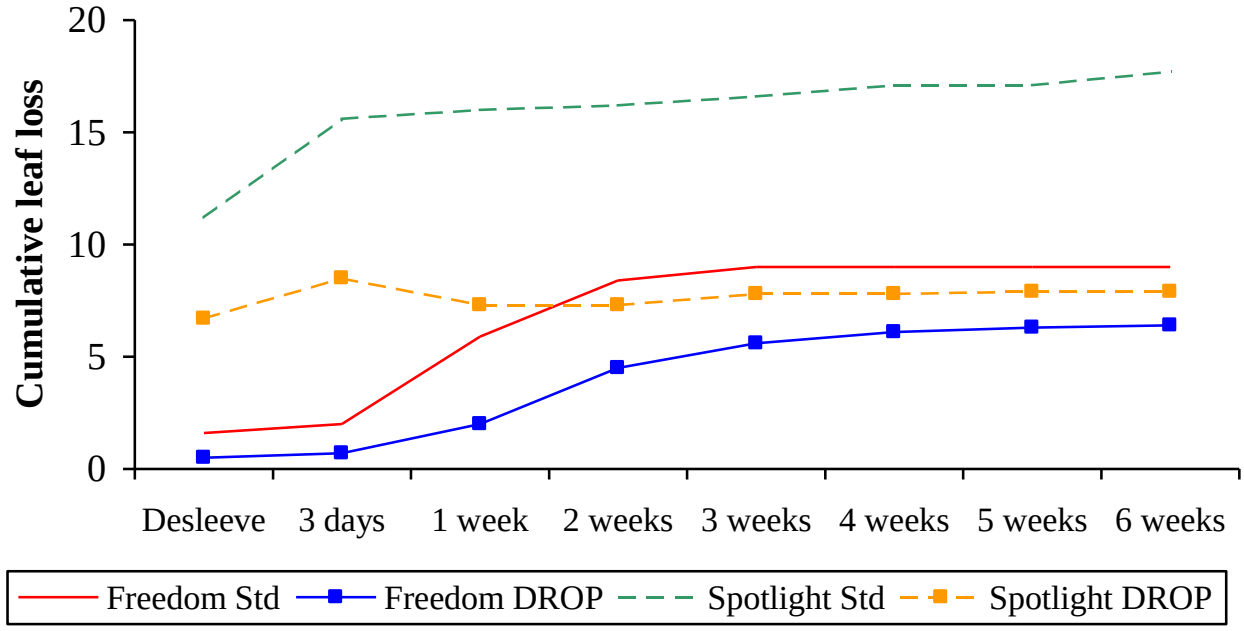
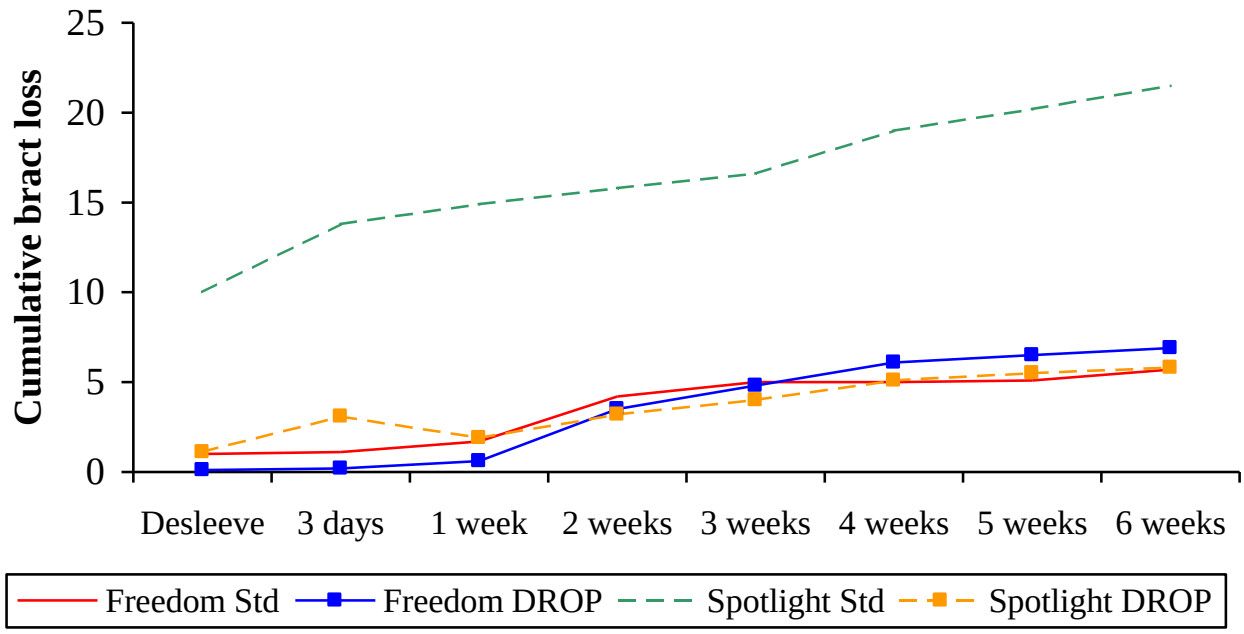


Figure 13: The cumulative bract drop for Freedom and Spotlight under the main temperature treatment.



The loss of cyathia was only affected by variety, and the effects of both DROP and PGR were negligible as in previous year's trials. In the first year DROP appeared to increase cyathia loss but this tended to be over the first weeks of shelf life, rather than over the full 6 weeks. This has not been noted in years two or three, and the varietal differences are always far greater. In this trial 3 days after Freedom entered shelf life it only had 78.8% of its cyathia left and after the full 6 weeks only 3% remained. Spotlight on the other hand lost more at desleeve, leaving 57.3%, but 30% remained throughout all 6 weeks. In previous years Sonora has retained higher numbers than Spotlight and had it not been for *Botrytis* would have probably performed in this way again (indeed in other Efford trials in 2000 this pattern was repeated).

As in previous years the incidence of disease in this shelf life study was very low, with one or two plants getting gold spot or *Botrytis*, but no treatment effects. The paling of bracts as shelf life went on was apparent in all treatment plants but no treatment effect was apparent, Freedom paled more than Spotlight, but as poinsettia variety trials have shown, each variety is different and colour is a very subjective criterion to judge shelf life on.

Poinsettia Tracker ™ V1.0

This three year study into reducing PGR applications was also designed to produce data for the development of an improved tracking system for UK poinsettia production. Analysis and programming was carried out by Tom Harwood at University of Reading. The development of a UK track took three stages and in summer 2001 Poinsettia Tracker™ was released to HDC levy payers.

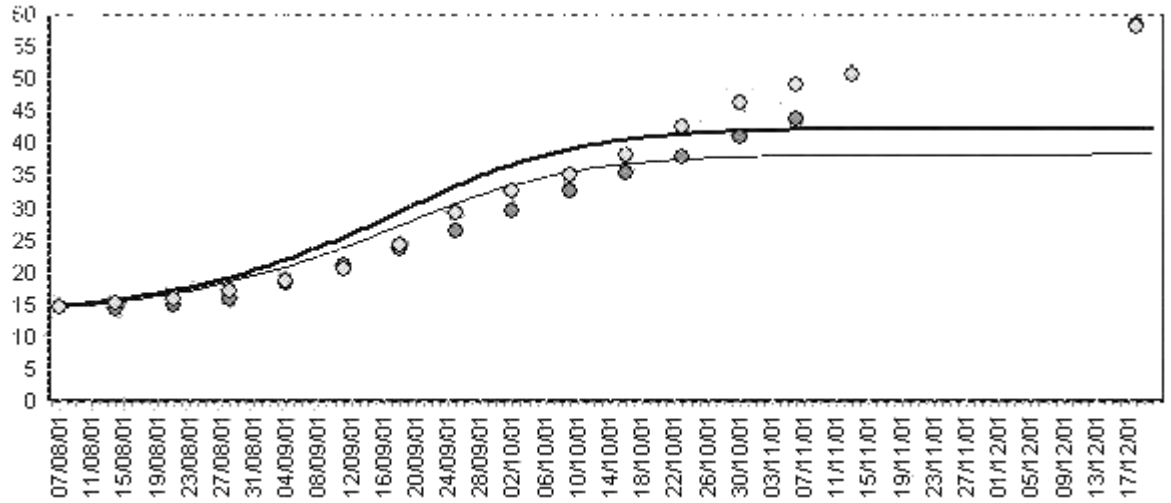
PGR Response Modelling

Experimental data for the 1998, 1999 and 2000 season trials were examined to assess suitability for PGR and DROP response modelling as distinct from the development of target tracks. It was concluded that additional data was required, based on timed applications according to a set experimental design, allowing the plants to drift off commercial track. Several seasons' worth of specifically targeted experiments would be required to develop response models, and it was decided not to pursue this option at this time.

UK Target Tracks

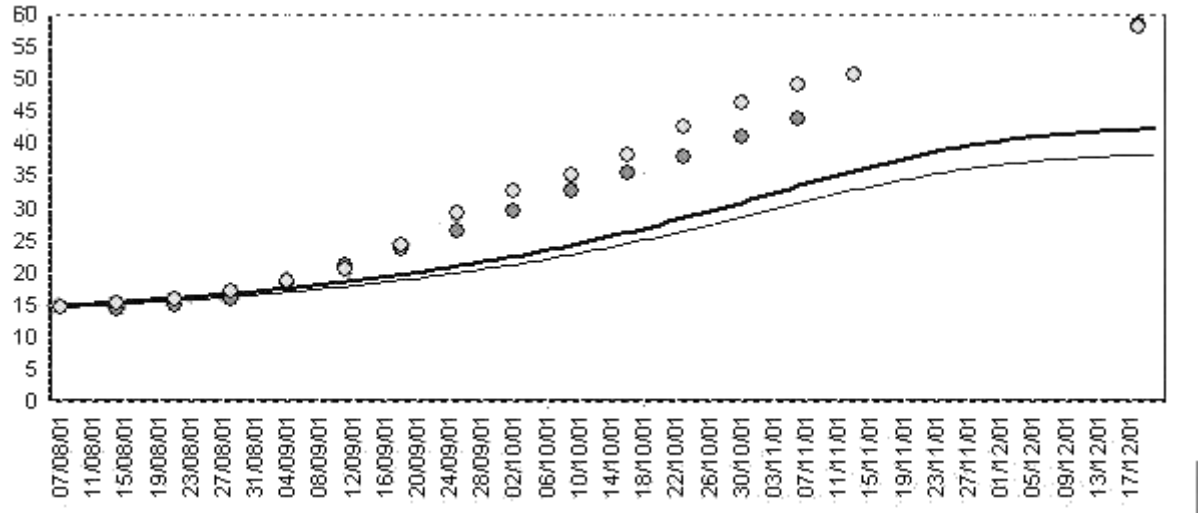
The use of target tracks developed at other latitudes or for a different growing season can give misleading information as to when and how frequently to apply PGRs. It is a matter of concern that any UK grower should use the UNH Floratrack tracks, since this requires that plants are brought up to specification early, and then held until marketing. Such a regime can be expected to bring about excessive use of PGRs, contrary to the principle of timely application on which the tracking approach is based (Fig 14).

Figure 14: The 1998 and 1999 poinsettia tracks for unregulated plants at Efford (○ represent growth) against the UNH 'ideal' track.



The 1998, 1999 and 2000 Efford unregulated plots were used to develop UK specific tracks for the Christmas poinsettia market. Unregulated plots are used as this shows pinched poinsettia growth alone, that is with no effects of DROP or PGR. It was found that the data showed consistent trends across seasons, and that the generalised logistic curve (Richards, 1969) could be fitted to actual growth curves for a range of seasons and PGR regimes (including untreated curves), with common parameters, by varying only the upper asymptote according to final height. It was concluded that the generalised logistic curve would provide a good basis for a flexible UK track, where upper and lower asymptotes could be adjusted according to pinch height and market specifications. Two UK target tracks were developed, by fitting the generalised logistic curve to experimental data collected at Efford, on the south coast (UK south, Fig 15), and on commercial data provided by Coletta and Tyson at Woodmansey, near Hull (UK north).

Figure 15: The 1998 and 1999 poinsettia tracks for unregulated plants at Efford (○ represent growth) against the Tracker 'UK South' track.



Poinsettia Tracker™

A stand-alone Windows based graphical tracking application was developed in consultation with growers to assist in height management in UK Poinsettia. This extends the functionality of the University of New Hampshire tracking tool ('Floratrack', Paul Fisher, 1997) developed for US Poinsettia and similar tracking tools. The Poinsettia Tracker application provides target curves tailored to the UK climate, (UK North and UK South), as described above, multiple crop editing and the ability to create user defined target tracks. A grower workshop was carried out to provide training in the use of the software, which will be commercially tested in the 2001 season.

2.5 *Conclusions*

- DROP reduces the number of PGR applications required to produce marketable poinsettias by up to one third (in all three years).
- Stronger acting PGRs, especially Bonzi, reduce the number of applications required to produce marketable poinsettias by up to 70% (in all three years).
- DROP can cause some varieties to colour and flower earlier (Spotlight but not Sonora), but only by a day or two so scheduling should not be a problem (in all three years).
- Early applications of PGRs do not reduce total required applications, but those early treated varieties do appear to be of higher quality.
- Late application of Bonzi to the foliage (after colouring has begun) causes a delay in bract colouring and a reduced bract size.
- DROP reduces leaf (2 of 3 years) and bract (all years) loss in shelf life, in particular for Spotlight.
- Poinsettia plants treated with cycocel and alar loose additional leaves in shelf life.
- Early PGR application reduces leaf loss in shelf life.
- DROP is not sufficient by itself to control poinsettia to a marketable size, but should be part of normal management as it reduces PGR applications (therefore labour) and improves shelf life.
- Poinsettia Tracker has been developed to fit UK poinsettia growth better than other alternatives.

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