ANNUAL REPORT

Poinsettia: Strategies for the reduction of plant growth regulator use

Year 2 Report
PC 155
(December 2000)

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Contents

The results and conclusions in this report are based on an investigation conducted over one year. The conditions under which the experiment was carried out and the results obtained have been reported with detail and accuracy. However because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results especially if they are used as the basis for commercial product recommendations.

1 PRACTICAL SECTION FOR GROWERS

1.1 *Background & Objectives*

Over the past two years, HDC-funded work (PC 155) has looked at the potential for using different plant growth regulators (PGRs), in combination with DROP (3 hour post dawn venting), as techniques for reducing the inputs of chemical PGRs during poinsettia production. This has important implications both for the environment, retailer and customer satisfaction. It may also lead to more cost-effective use of chemicals by the growers. Additionally, as more chemicals are being reviewed, the range of plant growth regulators available to the protected ornamentals industry is likely to be reduced.

The 1998-99 trial demonstrated that, within a given temperature environment, the use of stronger acting PGRs resulted in high quality plants without compromising post-harvest performance. Although DROP on its own was ineffective in controlling plant height, when used in combination with PGRs, further reductions in the number of PGR applications required could be achieved. The data also indicated that reduced PGR inputs may in fact benefit plants in terms of post-harvest bract retention. The work has stimulated great grower interest, but the industry needs information on season-to-season variability and repeatability of the treatment effects. For this reason, a second season's data was needed to confirm the 1998 trial results and add to the understanding of interactions between growing environment, chemical PGR use and their effects on plant quality and post-harvest performance.

In order to fully develop PGR-free techniques, we need to address not only the way a) chemicals are applied and, b) the temperature is managed, but also to question the way in which we currently use graphical tracking as a management tool. It is becoming increasingly evident, that the UK growing environment may benefit from a new decision-making tool that improves on the rather static tracks currently available. The proposed work programme aims, to develop an integrated software package over the next 3 years that can be tailored specifically for UK growers, and will ultimately be compatible with environmental control software.

1.2 *Summary of Results*

The following table gives the major findings from years 1 and 2 of this project for 2 poinsettia varieties Spotlight and Sonora. It enables growers to see where consistent results have been found and where differences exist.

Effect	Result	
	1998 Year 1	**1999 Year 2**
4 weeks after potting		
Height	No difference	Sonora taller
Breaks	Sonora 6.8	Sonora 5.8
	Spotlight 6.1	Spotlight 5.4
Uniformity	No difference	No difference
Effect of DROP		
Sharpening of response to short days	Yes	Yes
Advances crop (by 3 days), both colour and cyathia	Yes	Yes
Shortens crop (height)	No	Yes
Improves PGR response	Yes	Yes
Effect of PGR		
More uniform crop	Yes	Yes
Stronger PGRs requiring fewer applications	Yes	Yes
Marketing		
DROP reduced plant spread	Yes	Yes
DROP gave paler bracts	Yes	No
DROP reduced cyathia number and maturity	Yes	No
PGR reduced plant spread	Yes	Yes
PGR increased secondary growth	Yes	Yes (Sonora worse)
PGR reduced bract size	Yes	Spotlight yes, Sonora no
Shelf Life		
PGR increased green leaf loss	Yes	Yes (Cycocel lowest)
Bonzi increased cyathia loss	Yes	Only in first week
DROP reduced green leaf loss overall	Yes	Yes, but not at de-sleeve
DROP lowered necrosis and paling	Yes	Yes, but not consistently
DROP reduced bract loss	Yes	No (only Sonora)
DROP increased cyathia loss	Yes	No (only Spotlight)
Filters increased cyathia loss	Yes	N/A
Bracts pale	Yes	DROP paled slower
Sonora lost more leaf than Spotlight	Yes	Yes
Sonora kept cyathia longer than Spotlight	Yes	Yes

1.3 *Action points for Growers*

- Use DROP and positive boosts as part of an integrated crop management tool to reduce PGR inputs and control plant height.
- If using DROP as primary control for height the response time of the crop may need shortening (Spotlight 1 week, Sonora ½ week shorter).
- The use of DROP at initiation appears to improve the evenness of the response.
- Alar alone works as a PGR on poinsettia and has additive effects when mixed with Cycocel.
- The interaction between DROP and strong acting PGRs on shelf life has been variable over the two years of this study, and it is too early to say which combination is best for shelf life.
- The observation that there may be an interaction between the efficacy of a chemical PGR and the day/night temperature regime is new, and further work is required on this aspect before recommendations can be made regarding the best uses of this technique.

1.4 *Practical and Anticipated Financial benefits*

Although using stronger acting PGRs may reduce labour costs on a nursery, the increased chemical costs often mitigate any financial benefits. The major benefit to the industry is that they will continue to meet the increasing demands for environmentally friendly production techniques by reducing PGR inputs. These benefits are difficult to quantify, but satisfying supermarket QA schemes, without reducing plant quality, ensures that UK growers maintain their competitive edge 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 increasingly 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 in the future, 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 (PC 41). Data from the first year of this project (PC 155), indicated that DROP, on its own, was ineffective in controlling poinsettia height. DROP has been shown to work well in situations where temperatures outside are low and light levels are good, as in some of the US poinsettia production areas. The UK 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 1998-99 season demonstrated that chemical PGRs used in conjunction with DROP, appeared 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 the stronger-acting Bonzi and Alar/Cycocel mixes without compromising plant quality or post-harvest performance.

It was demonstrated that the Alar/Cycocel mix was more powerful in controlling plant height than Cycocel alone. However, there is no data to demonstrate whether the effects of these chemicals are additive or synergistic when combined. The popular belief within the industry is that Alar is ineffective in controlling poinsettia when used on its own, but if this is the case, then the mechanism for its enhanced action when combined with Cycocel is interesting and needs to be examined. For this reason an Alar treatment was included in the second year trial.

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. This means

the growth model track adopts a slow growth rate early in the crop, with an increase after 3 – 4 weeks. In the UK, the best light levels are at the start of production, which tends to mean that currently UK crops are over-regulated early in the season. It may be better to take full advantage of the light conditions early on, to develop the crop structure and stature, only applying regulators later. This project aims to develop a new graphical track for the UK that optimises the growers' use of favourable conditions early in production. The addition of a decision tool could also take account of seasonal variability, and be an aid in making predictive decisions concerning PGR applications. This decision tool would need to account for variety vigour, response time, weather data, and growth responses over the previous weeks, in order to predict growth and assign probabilities to different options. It should be able to inform the grower of the best options at that point in the growing season for height control by using a range of PGRs / temperature corrections.

This second year's trial aimed to confirm the effective use of a number of PGRs in combination with DROP to reduce the PGR inputs to a poinsettia crop and provide data for the development of a UK track.

2.2 *Objectives (Year 2)*

- To further investigate the effects of different plant growth regulators as a height control tool in natural season poinsettia crops
- To study the interactions between PGR and DROP treatments.
- To compare the effects of using an Alar / Cycocel mix to control height against the effectiveness of Alar or Cycocel alone.
- To examine the impact of each treatment on the shelf life.
- To quantify the chemical and labour costs of each treatment per unit area, to allow comparative costs to be examined.

2.3 *Materials and Methods*

2.3.1 Glasshouse site

The trial was carried out in compartments 1 and 2 of Q Block at HRI Efford. Q Block has 4 compartments running north – south each measuring 30m by 10m. Within each compartment there are 3 rows comprising of 4 rolling benches, each measuring 7m by 1.7m. Irrigation is by hand via capillary matting.

2.3.2 Experimental design

Poinsettias were produced in 13cm pots to UK production specifications, that is at marketing a 38-42cm plant (measured from the bench) having 5 breaks with level bract heads above the canopy. Two poinsettia varieties of contrasting vigour were chosen to represent typical commercial varieties. These were Spotlight (Dümmen, vigorous, 9 week response time) and Sonora (Fischer, less vigorous, 9 week response time).

The trial design needed to compare the effectiveness of DROP on different PGR treatments during poinsettia production. This was achieved using a split plot design with the main experimental split being between standard temperature and a DROP regime. This was achieved by having each temperature regime in a single glasshouse compartment. Q1 ran the DROP treatment and Q2 ran the standard temperature regime. Within each temperature regime 5 PGR treatments were imposed each replicated twice within the compartment. The PGR treatments were:

- No PGR
- Cycocel (commercial standard, $1ml^{-1}$at start of season increasing to $2ml^{-1}$ later)
- Alar (applied at 300 ppm for Spotlight and 500 ppm for Sonora)
- Alar / Cycocel mix (applied at 300 ppm each for Spotlight and 500 ppm each for Sonora)
- Bonzi ($1ml^{-1}$ applied to breaks until wet, avoiding run off)

This gave an experimental design of 10 treatments for each variety allowing an ANOVA to be used to discern differences in variety responses as well as treatment differences. The final experimental design was:

2 varieties x 2 temperatures x 5 PGR treatments x 2 replicates = 40 plots.

During production each treatment plot was monitored using the UNH Floratrack graphical tracking system for poinsettia. Each week the height of 6 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 was higher than predicted for that week then growth regulator was applied. This strict criteria for applying PGR's meant the primary control for height was temperature and no cycocel was used to 'shape' the plants, in order to examine the main effect of each PGR.

2.3.3 Production

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

Immediately after potting, plants were fleeced for a week to aid early establishment. During the first week screens were also 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, at which point daylength extension lighting was provided (six 400W SON-T's per compartment) from 17:00h to 21:00h until 20th September, after which short days were maintained by screening the crop in order to promote flowering. A 9 week response was used for Spotlight and an 8 week response for Sonora, in the standard temperature regime, while 8 and 7½ week responses respectively were used in the DROP environment. This was to take account of advanced bract colour development shown in the DROP regime in the first year; Spotlight appearing to be more sensitive to DROP than Sonora.

The feed of a poinsettia crop is changed regularly through its production in order to respond to the growth requirements of the plants as they grow. The feed was applied to all treatments as standard, so 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 24-40: 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 of *Hypoaspis miles*. Any Whitefly was controlled with *Encarsia formosa* introduced weekly until week 45.

2.3.4 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: 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
  - Stage 6 = abscission
- Score of overall quality
  - 0 = Unmarketable (few uneven heads)
  - 1 = Second Grade (3 – 4 heads above canopy)
  - 2 = First Grade (5-6 coloured heads on the canopy)

Environmental analysis

- Media analysis, at potting and at 2 weekly intervals thereafter

- Liquid feed analysis, fortnightly 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

2.3.5 Statistical analysis

The data were analysed using standard ANOVA. Data that needed transformation was 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 is also be cited in the results.

2.4. *Results and Discussion*

In assessments where there was no varietal difference then results have been averaged across variety and statistical analysis presented of main treatment effects only. If there was interaction between varieties and treatment then full results have been shown to demonstrate varietal differences.

2.4.1 Environmental data

The light receipt in 1999 was slightly lower than in 1998, especially in the first weeks after potting (Fig 1), but similar overall compared to the long term average. In fact the light early in the crop was still somewhat higher than would be expected, based on the long term data set although week 32 had particularly poor light. This poor light had little effect on the crop as they had only been planted recently and therefore screens were used if the radiation was too high.

Figure 1: The 1999 solar radiation (MJ/m^2/day) compared to the 1998 data and the long term mean.

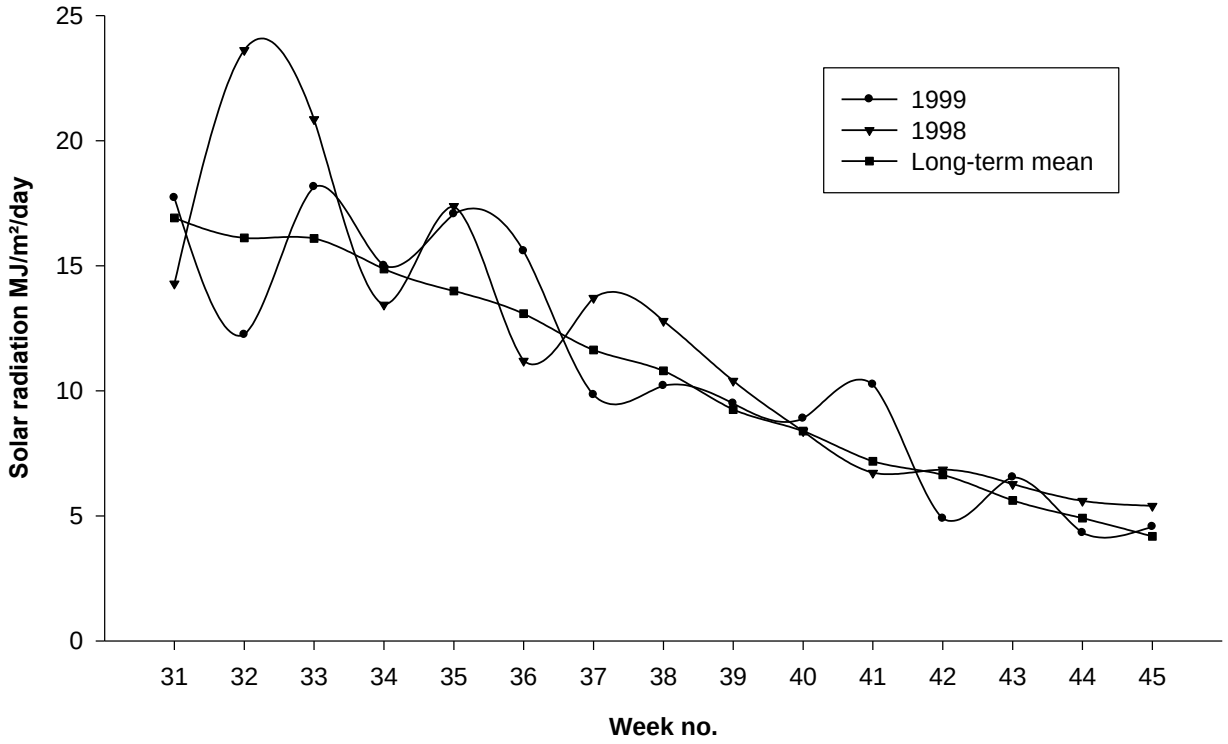
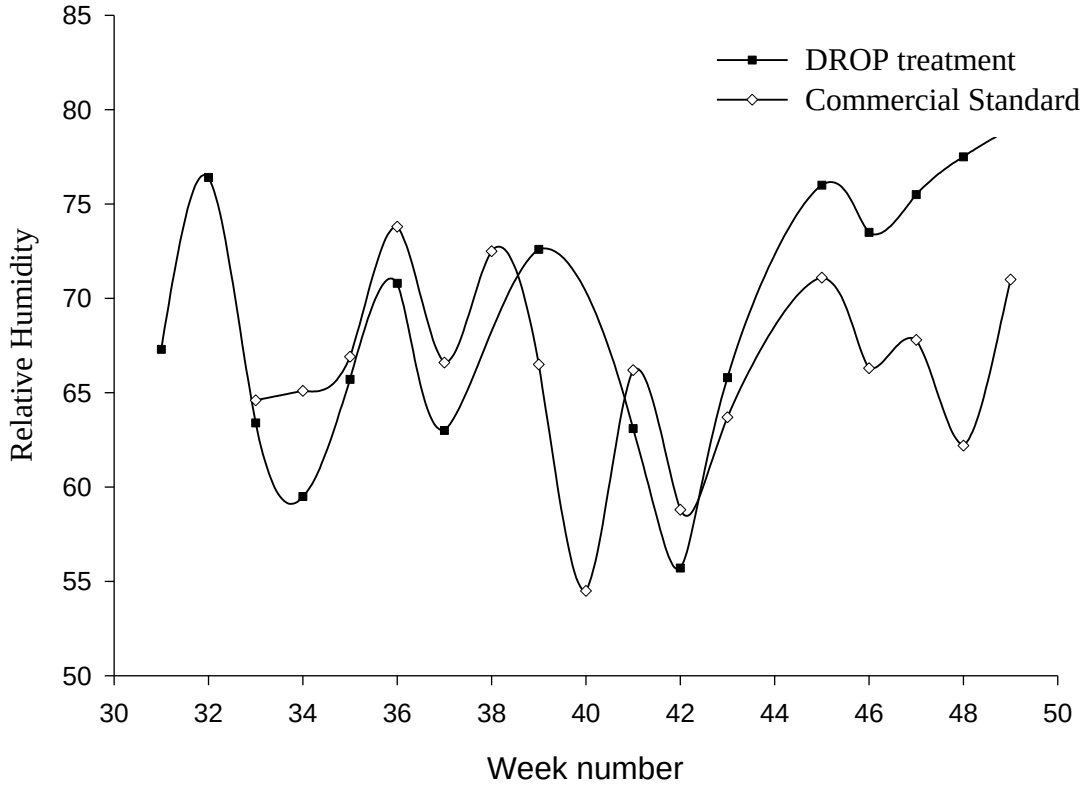


Figure 2: The average humidity maintained in the standard and DROP compartments 1999.



The humidity was maintained at 70% for the duration of the crop. An issue was that when DROP was applied the vents often stay closed for longer during the rest of the day in an attempt to achieve similar 24hr average temperatures, and this raised humidity in the DROP compartment (Fig 2).

During the same period the temperatures in the compartments were gradually reduced from an average 23ºC to 19ºC (Fig 3). When the light and temperatures were compared, one can see that the especially poor week 32 also had lower compartment temperatures. The DROP compartment remained at an average temperature of 24ºC during the first 8 weeks of production, but was lower in the last quarter. The reduced average temperature reflects the DROP that was applied. The achieved DROP was on average 4ºC, while the maximum DROP was often 6ºC (greatest was 10ºC). This demonstrates that setting lower set points allows one to achieve an average DROP at a desired temperature, which is particularly difficult in the warmer South of the country (Fig 4).

Figure 3: The average temperature maintained in the standard and DROP compartments 1999.

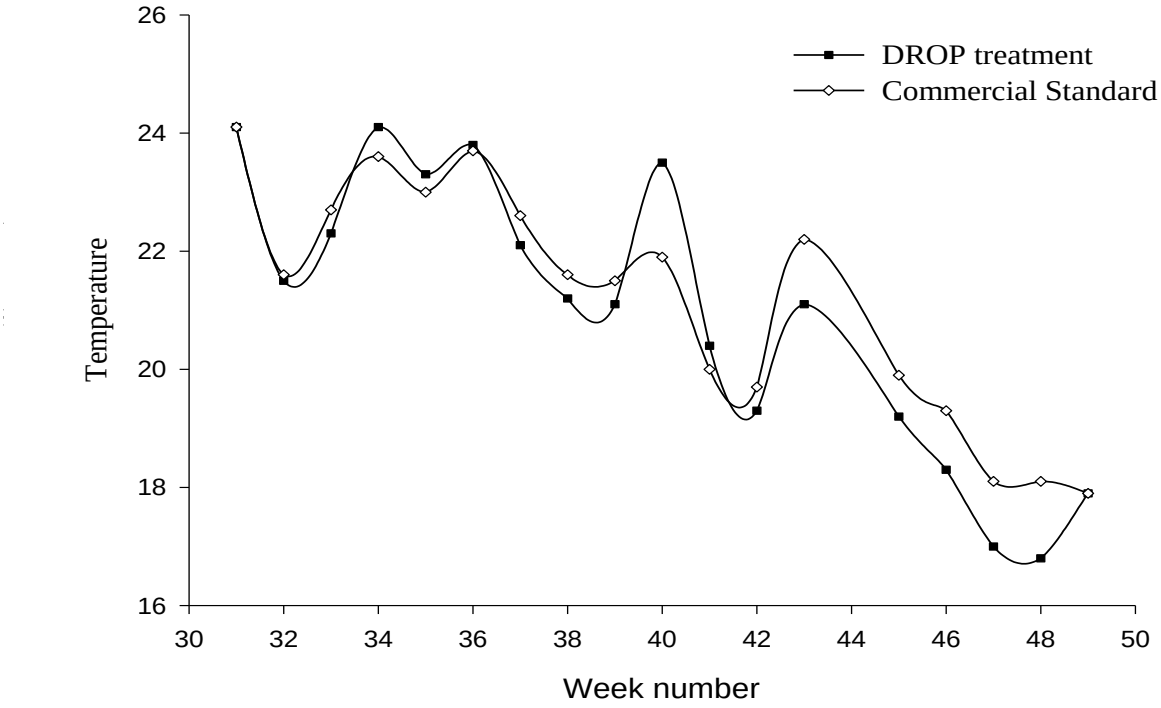
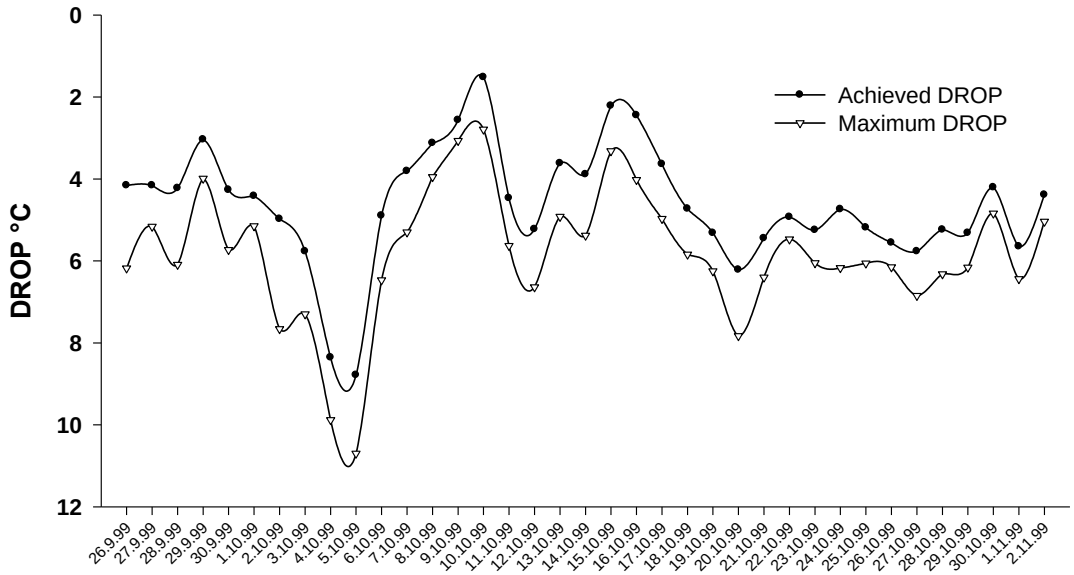


Figure 4: The average achieved DROP and the maximum DROP achieved in 1999.



2.4.2 Data 4 weeks after potting

These records were carried out before the treatments began just after the plants had been pinched. The main reason for this is to identify any pre treatment differences. While the uniformity within each variety was similar there were differences in heights and breaking between them. On average Sonora was slightly taller (17.5 cm from the bench) and broke slightly better (5.8 breaks per plant) than Spotlight (15.9 cm and 5.4 breaks). This difference was purely varietal and simply emphasises the increased vigour Sonora has demonstrated over Spotlight in recent years.

2.4.3 Effects of DROP during production

The effect of DROP on time to first colour was shown in year 1 to be advanced in the DROP treatments. In year 2 response times for each variety were therefore shortened (Spotlight shorter by 1 week and Sonora by ½ week). Time to first colour was therefore not effected by DROP alone, and average time to colour for both varieties was 54 days. The evenness of the response appeared greater in the DROP compartment; however, with so many interacting treatment effects it is difficult to assess whether this was just an artefact or a real benefit. The first cyathia was delayed slightly by DROP, in both varieties it took one day longer to produce cyathia than in the standard treatment. This delay is less than the difference between varieties, Spotlight generally taking 2 days longer to produce cyathia than Sonora, so the speed of cyathia production is probably not a concern in commercial production.

The effect of DROP on plant height during production was generally to keep them shorter (Figs 5 & 6). The main benefit of DROP observed in the first year was an apparent improvement in PGR response as a result of the lower morning temperatures. This result was confirmed in this second year and it led to a reduction in the number of PGR applications required on both varieties in the DROP compartment (Table 1). Year 1 also highlighted the problems of the track not being appropriate for UK conditions, especially early in the growing period. The fact that most plants were shorter than the track for the early part of production was indicative of this, and any improvements to a UK track would have to accommodate the vigorous growth early in a crop.

Table 1: Mean number of applications of PGRs in Standard and DROP environments.

Variety	Standard	DROP
Spotlight	1.9	2.7*
Sonora	12.8	14.9*

5% LSD = 0.642 for comparison of means

* Significantly different from the standard temperature regime ($P < 0.001$)

Figure 5: The graphical track for Spotlight with each PGR in standard and DROP treatments. The predicted curve has been included for information.

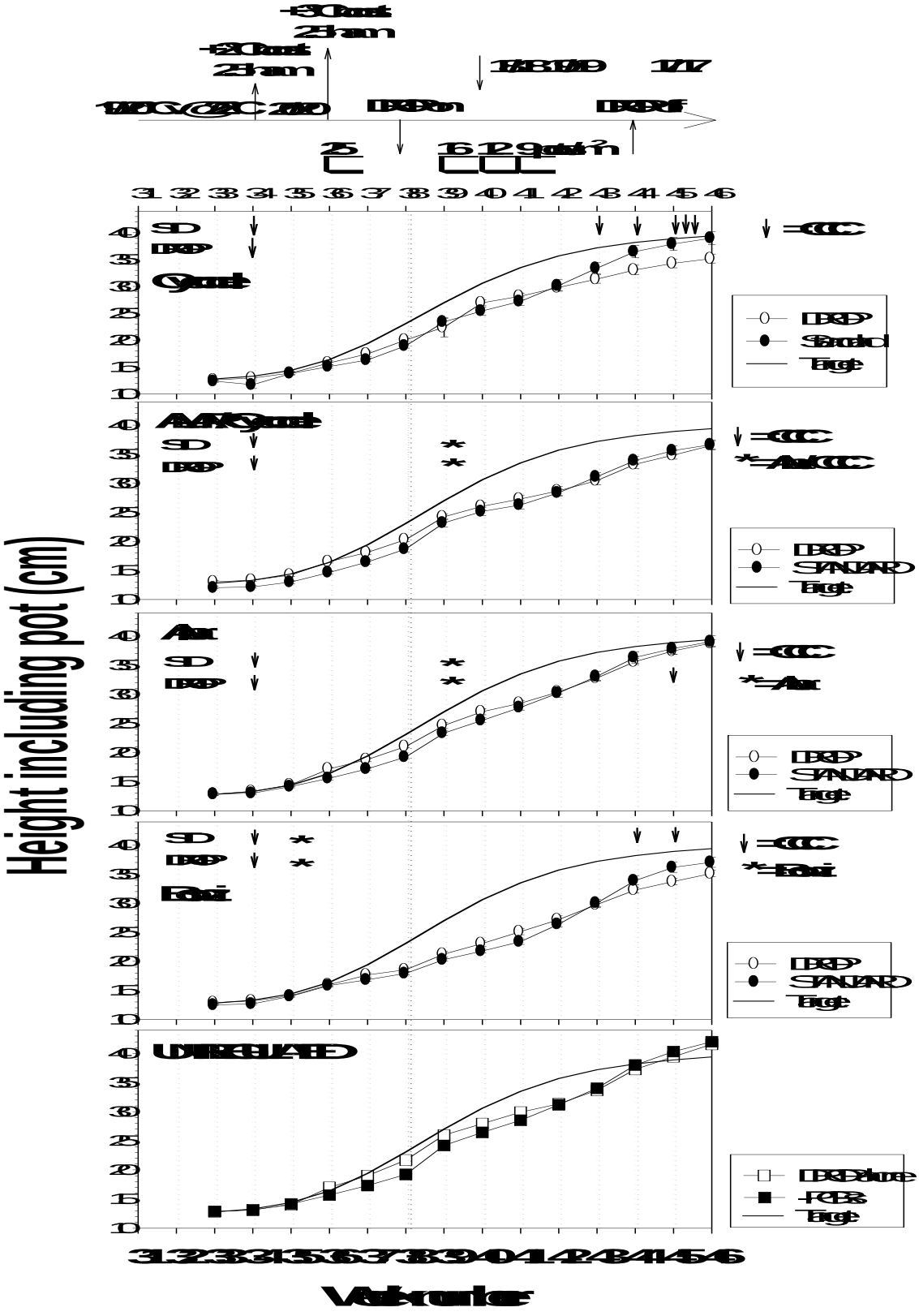
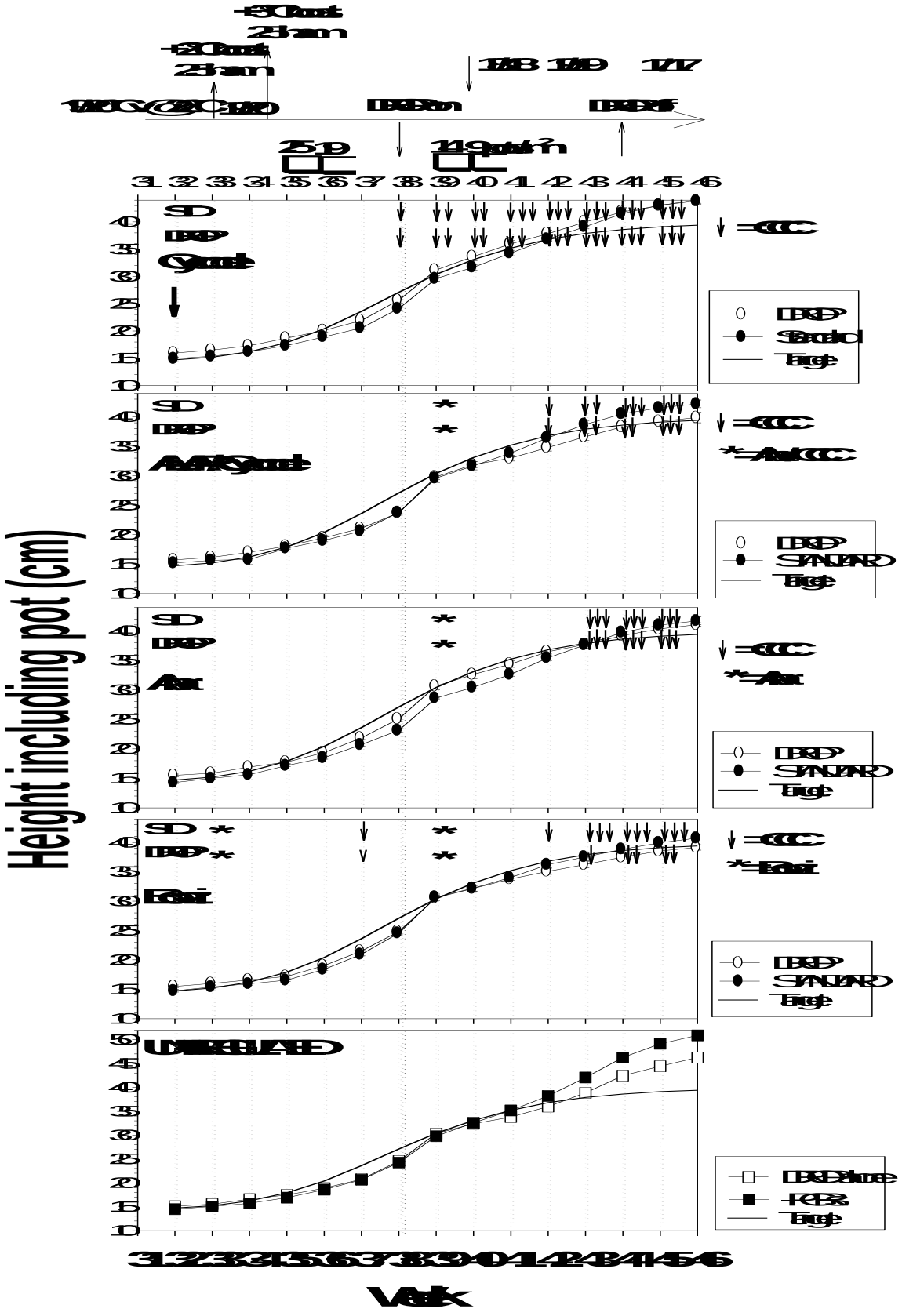


Figure 6: The graphical track for Sonora with each PGR in standard and DROP treatments. The predicted curve has been included for information.



2.4.4 Effects of PGR applications during production

As in year 1 the effect of PGRs when compared to unregulated plants was to reduce height (Figs 5 & 6), sharpen response (especially with Bonzi) and give a more uniform crop. The growing season in 1999, as highlighted earlier meant that very few application of PGRs were required early on in crop growth. As a rigid protocol to look at responses to specific PGRs was the rational no cycocel was used for shaping. Using cycocel for shaping is essentially regulating the apical dominance of the highest growing tips and therefore strictly speaking is simply height control. This meant that many of the treatment plots, especially for Sonora, had a large number of Cycocel applications late in the crop, to control growth after the onset on short days, when stronger PGRs cannot be used.

The lack of early applications of PGRs meant that some of the treatment plots became more uneven than would be expected in a commercial situation. However, even in a season of very low applications, the stronger action PGR's required fewer late Cycocel applications (Table 2), which supports the evidence of the previous year's data.

Table 2: Number of applications of individual PGRs in Standard and DROP environments.

Variety	Standard		DROP	
	Spotlight	**Sonora**	**Spotlight**	**Sonora**
Cycocel	1	20	3.5*	21
Bonzi	1 (+1)	2 (+6)	1 (+2)*	2 (+12)*
Alar	1 (+1.5)	1 (+12)	1 (+1)	1 (+12)
Alar / Cycocel	1 (+1)	1 (+9)	1 (+1)	1 (+10.5)*

5% LSD = 1.012 for comparison of additional cycocel applications

* Significantly different from the standard temperature regime ($P < 0.05$)

2.4.5 Effect of DROP at marketing

As shown previously DROP alone was insufficient to control height of poinsettias to the specifications required by multiples. DROP did significantly reduce plant height(Table 3) especially in conjunction with PGRs. DROP also appeared to reduce the overall spread of the plant, however, the combination of a shorter stockier plant with the same number of bract heads can often appear better quality.

Table 3: Effect of DROP on plant height (cm) for each variety.

Variety	Standard	DROP
Spotlight	48.06	43.86*
Sonora	48.20	44.11*

5% LSD = 1.403 (10 d.f.) for comparison of means

* Significantly different from the standard temperature regime ($P < 0.001$)

Unlike the first year of the trial, DROP did not give paler bracts or reduce cyathia development. This is likely to be because the 1999-2000 season had lower light levels than the first year of the trial, and so the interaction between lower temperatures and high light levels, known to reduce cyathia development (PC71d, Miller & Heins 1986a,b), did not occur.

2.4.6 Effect of PGRs at marketing

As the crop canopy develops internodal stretch may become a problem, particularly in a season that has few PGR applications early in the crop. After crop initiation, advice is not to use the stronger acting PGRs in case of damage to the bract (although the evidence for this is sparse). In the absence of this it means that after the onset of short days only Cycocel is used which can be difficult to apply to the stems as the leaves have closed the canopy. This late season stretch lead to many of the poinsettias being too tall for supermarket specifications (Fig 7). The only treatments that were within height specification for both varieties were Bonzi and Alar / Cycocel mix. This is particularly interesting because the Bonzi plots only had 1 or 2 applications (depending on variety) one when the breaks were 2.5cm long and one just before initiation. That suggests that a few judicial applications of Bonzi early could be sufficient to regulate height, leaving fewer Cycocel applications for shaping alone later in the crop.

The other important feature of supermarket specifications is numbers of bract heads. The ideal model is for 5 to 6 bract heads at the same height. In all treatments a number of bract heads formed a second tier under the main canopy. The reduced number of early PGR applications exacerbated this two tiering, but the trend was the same as in year 1 (Fig 8). This problem is on the increase in commercial crops as growers increase the growing density of the poinsettia crop.

Figure 7: The mean height of both varieties of poinsettias from all PGR treatments and DROP. The grey shaded area marks UK supermarket specification.

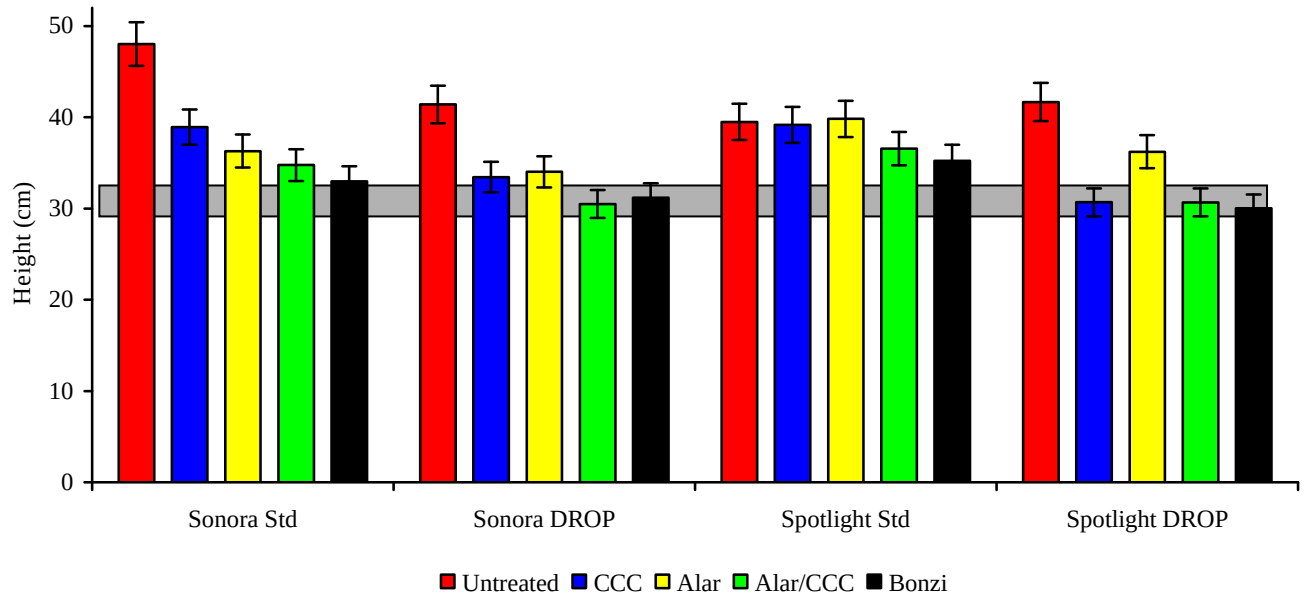
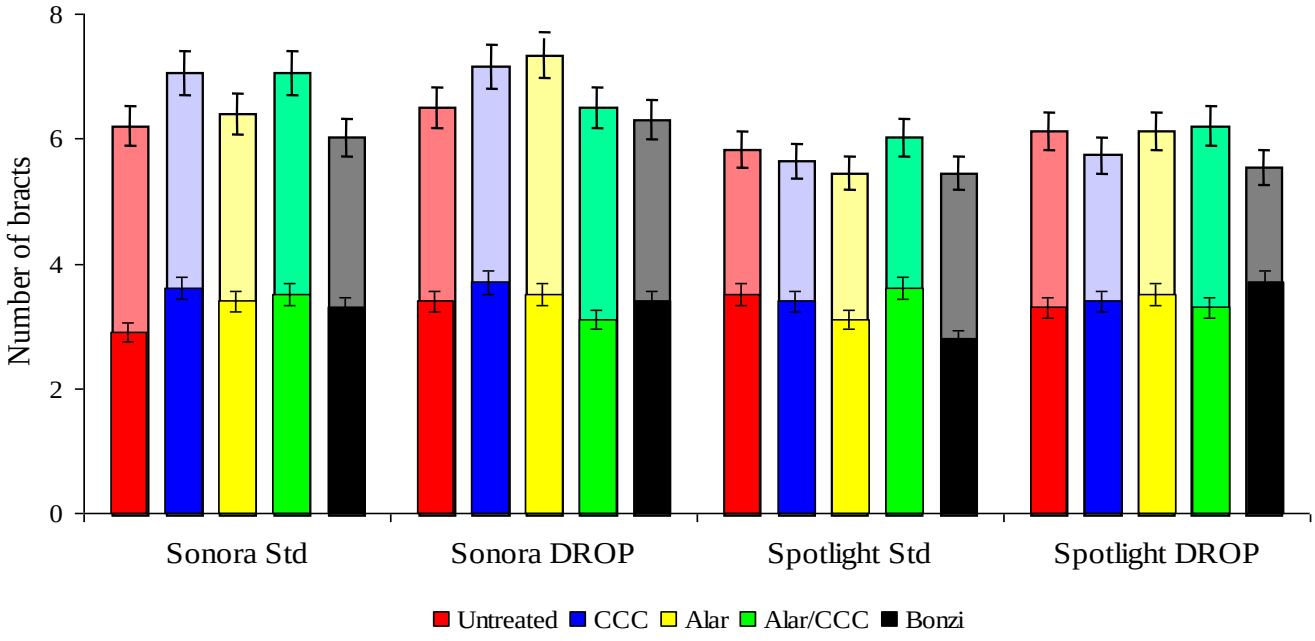


Figure 8: The number of bract heads on both varieties of poinsettias from all PGR treatments and DROP. The full bar is the total number of heads, while the lighter area are the secondary heads.



An important feature along with the numbers of bract heads, is the way that poinsettias present themselves in a sleeve. This is essentially a measure of width of the top of the plant. As in the first year of the work this was reduced by the application of PGRs, though differences between PGRs was not significant (Table 4). The actual size of the bract heads was also slightly reduced in PGR treatments when compared to unregulated plants, but the main difference in bract size was varietal, with Spotlight having larger bracts than Sonora.

Table 4: The mean width (cm) of Spotlight and Sonora. Measurements at 90º to each other and pooled across temperature effects to show main PGR effect.

	Spotlight		Sonora	
	Width 1	**Width 2**	**Width 1**	**Width 2**
Cycocel	63.02	56.08	52.73	48.13
Alar	63.52	56.17	52.15	46.92
Alar / Cycocel	62.76	56.27	50.57	44.70
Bonzi	61.32	54.40	52.92	48.63
Unregulated	64.47	57.25	59.57	54.51

5% LSD = 1.502 (8 d.f.) for comparison of means of PGR treatments

The PGR treatments are significantly different from the unregulated plots, but not from each other.

The overall quality assessment is a judgement of whether a plant has met the strict multiple requirements. It is an overall score from 0 that is an unacceptable plant to 2 that is a plant that meets specification. In both years of the trial more plants than would be commercially acceptable failed specification on one or more grounds. Plants failed most often on height specification, which in part is a result of having strict protocols for the application of PGRs. However, even with this constraint, in both years the use of PGRs increased the quality score, especially the stronger acting ones. This is not surprising because so much of supermarket specification relies on the height of the plant. The shortest plants presented a more compact appearance and were perceived as better quality.

2.4.7 Effects of DROP and PGR on post harvest quality

Very little consumer research has been carried out on the most crucial aspects for post harvest acceptability. The supermarkets are increasingly demanding to guarantee plants for a minimum period, however what the acceptable limits are for degradation during this period still needs further work. The results from the first year of this trial showed that PGRs had little obvious effects on post harvest performance, whereas the cooler growing conditions under DROP were generally beneficial to post

harvest performance with the exception of cyathia loss. Results in the second year were more variable, highlighting the problems of relying on a single year of data.

Very often the largest differences in post harvest performance are varietal. Indeed in both years of the trial Sonora lost far more leaves post harvest than Spotlight (Figs 9 & 10). In 1999- 2000 Sonora lost three times as many leaves. However Sonora often has more than 4 times as many leaves as Spotlight and many lower small leaves make up the bulk of leaves lost. Also Spotlight looses more bracts than Sonora (Figs 11 & 12). This may mean that an overall impression of Spotlight could be a plant with lost bracts and few leaves whereas Sonora can still have the appearance of good green cover and fewer lost bracts.

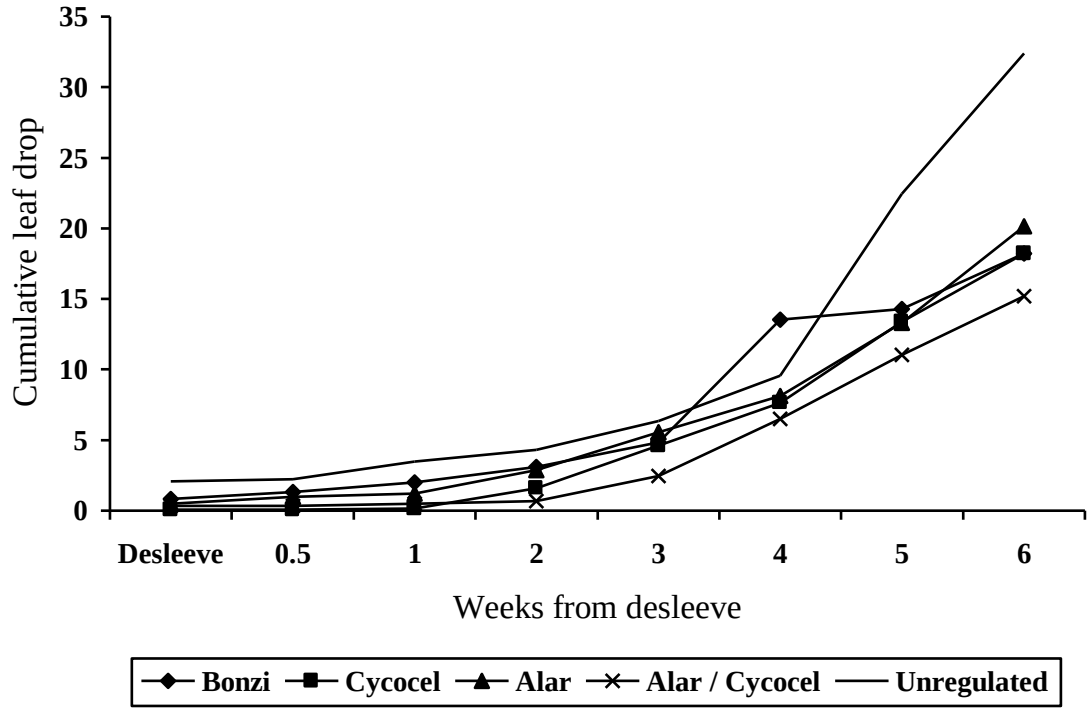
Leaf loss in year 1 was shown to increase with the use of PGRs. This trend was also true in the second year for Sonora (Fig 10). Spotlight in year 2 actually lost the most leaves in the unregulated plots (Fig 9). This may reflect the low numbers of PGR applications on Spotlight in year 2, compared with the higher number applied to Sonora (Table 2). This may indicate there is a threshold after which PGRs become deleterious, this is however outside the scope of this trial.

DROP was shown to reduce loss of green leaves also. Again this is only true in year 2 for Sonora (Fig 10), whereas Spotlight lost more green leaves under DROP (Fig 9). This highlights a real problem in assessing post harvest performance, since although in absolute terms any leaf loss can be seen as negative it may not detract from a consumer choosing a plant. What may effect a repeat sale more is leaves lost on desleeving, as this is perceived as poor quality. Marginally more leaves were lost at desleeving in the DROP treatment, although the numbers were low.

Bract loss may well be perceived as of more importance to quality than leaf loss and therefore treatments that increase this need to be understood. In year 1 DROP reduced bract loss, but in the second year it would appear that the reverse was true, with more bracts being lost in DROP treatments (Figs 11 & 12). However, the increase in bract loss occurred after week 3 for Sonora and week 4 for Spotlight, so both fall within the 21 day guarantee a multiple may wish to use. In year 1 bract loss was unaffected by PGRs, which was true for Spotlight in year 2 (Fig 11), but not for Sonora (Fig 12), which lost more bracts in all PGR treatments when compared to unregulated plants.

Figure 9: The cumulative leaf drop of Spotlight with each PGR in (a) standard and (b) DROP treatments.

a.



b.

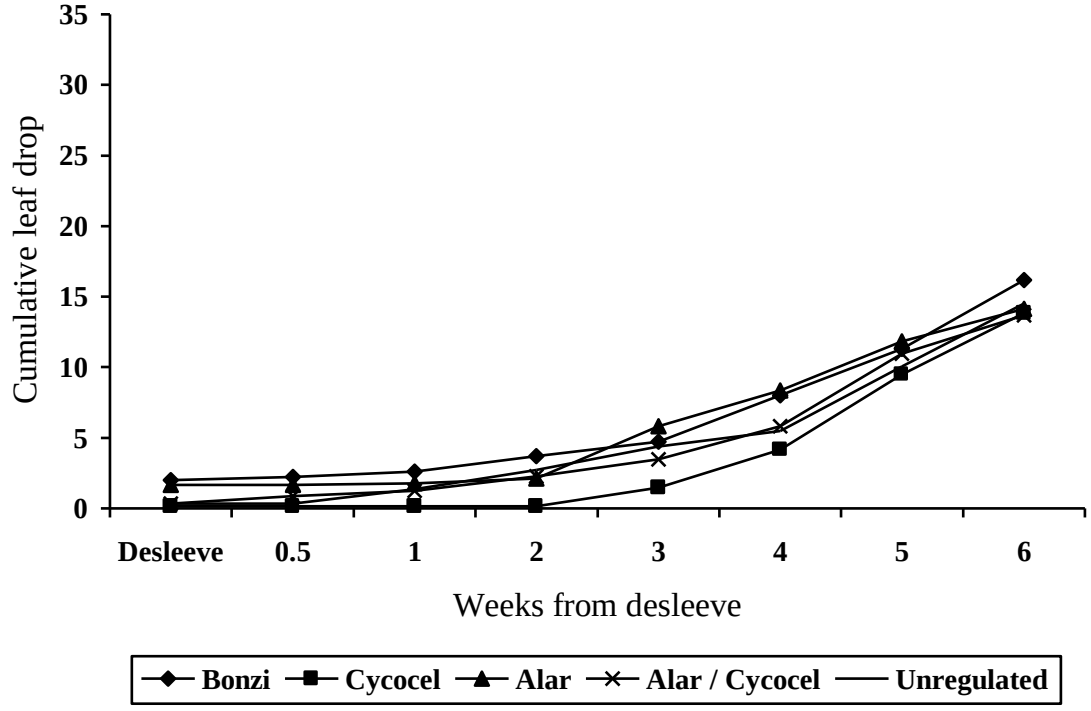
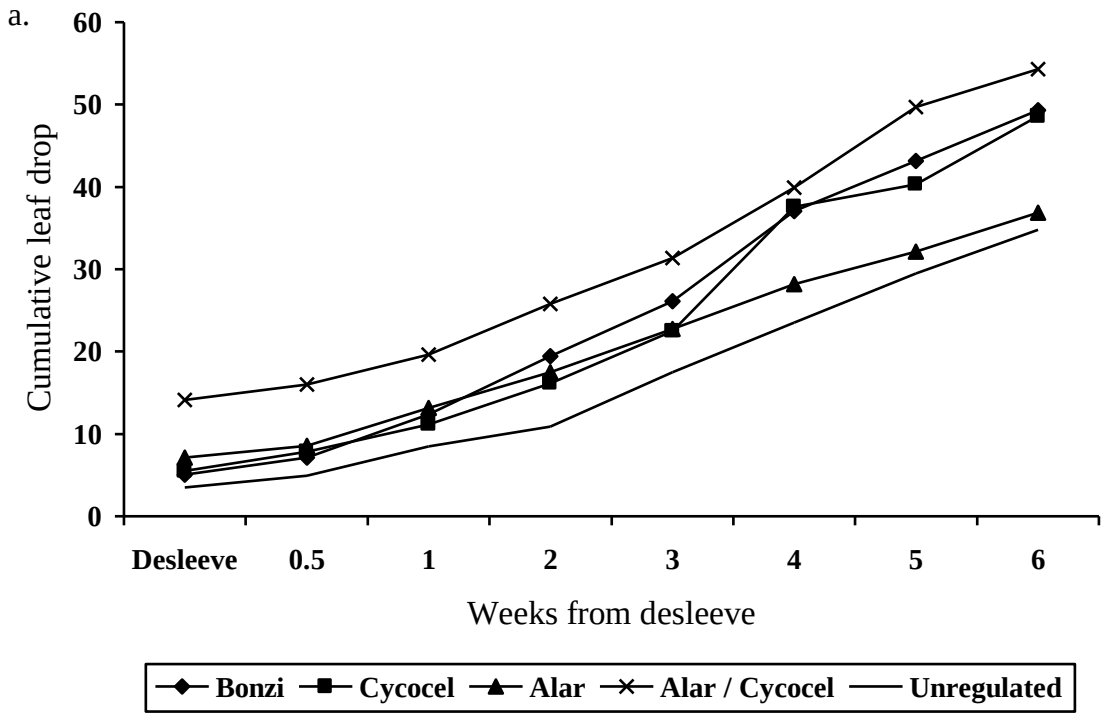


Figure 10: The cumulative leaf drop of Sonora with each PGR in (a) standard and (b) DROP treatments.

a.



b.

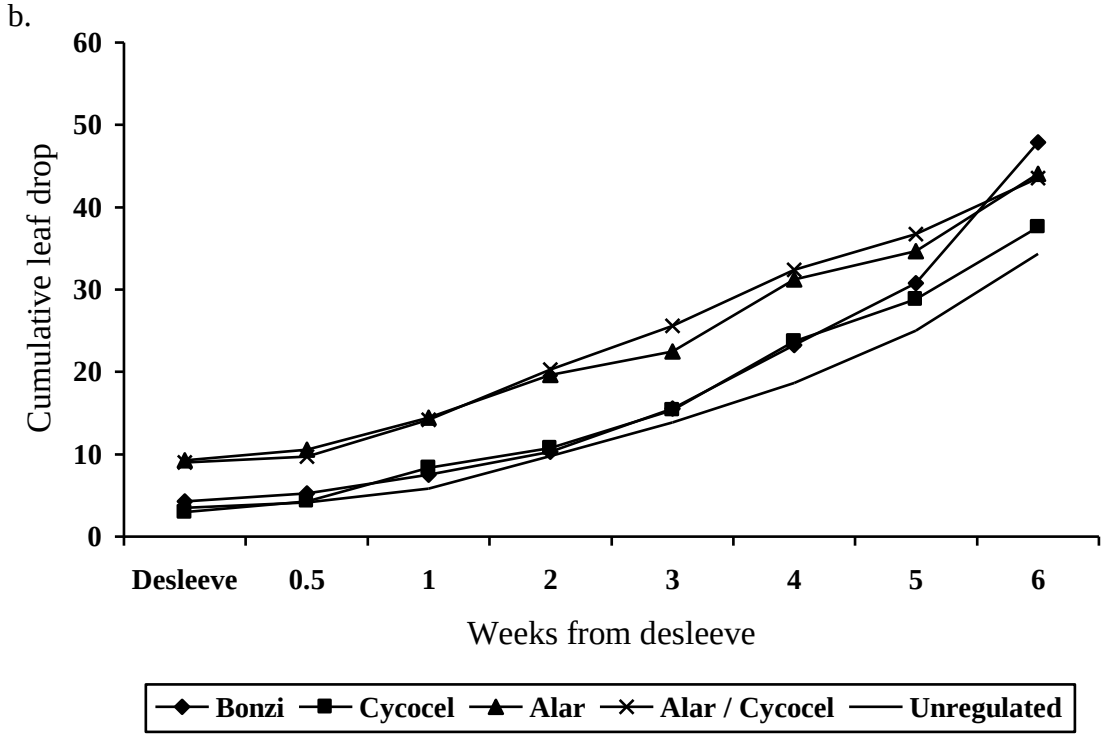
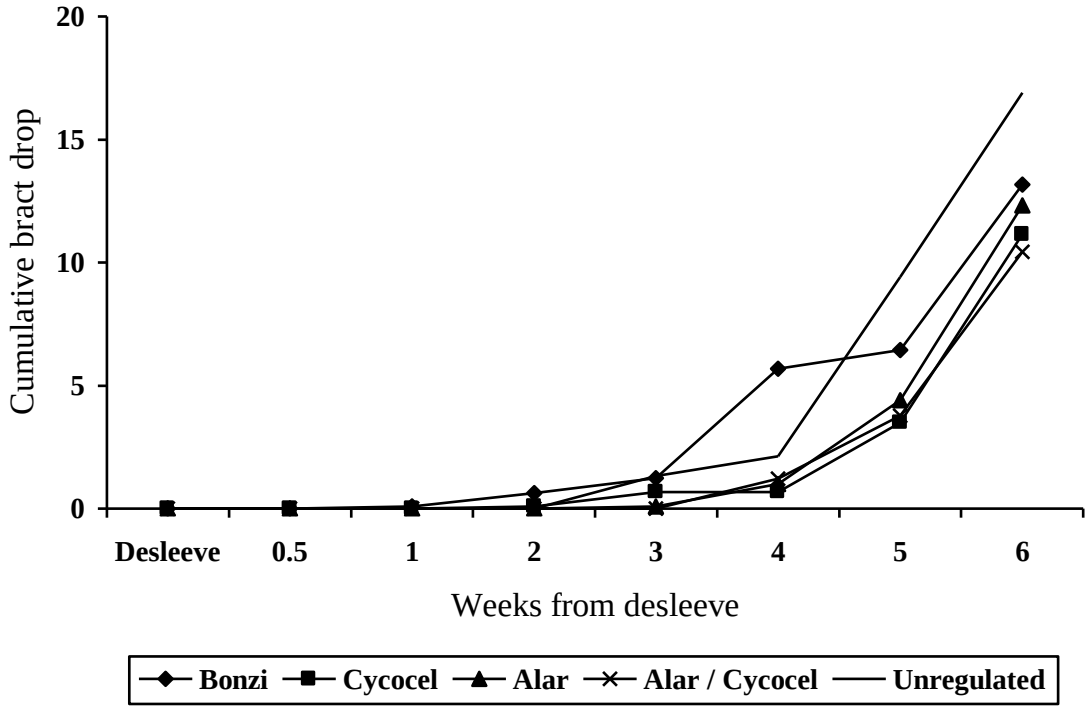


Figure 11: The cumulative bract drop of Spotlight with each PGR in (a) standard and (b) DROP treatments.

a.



b.

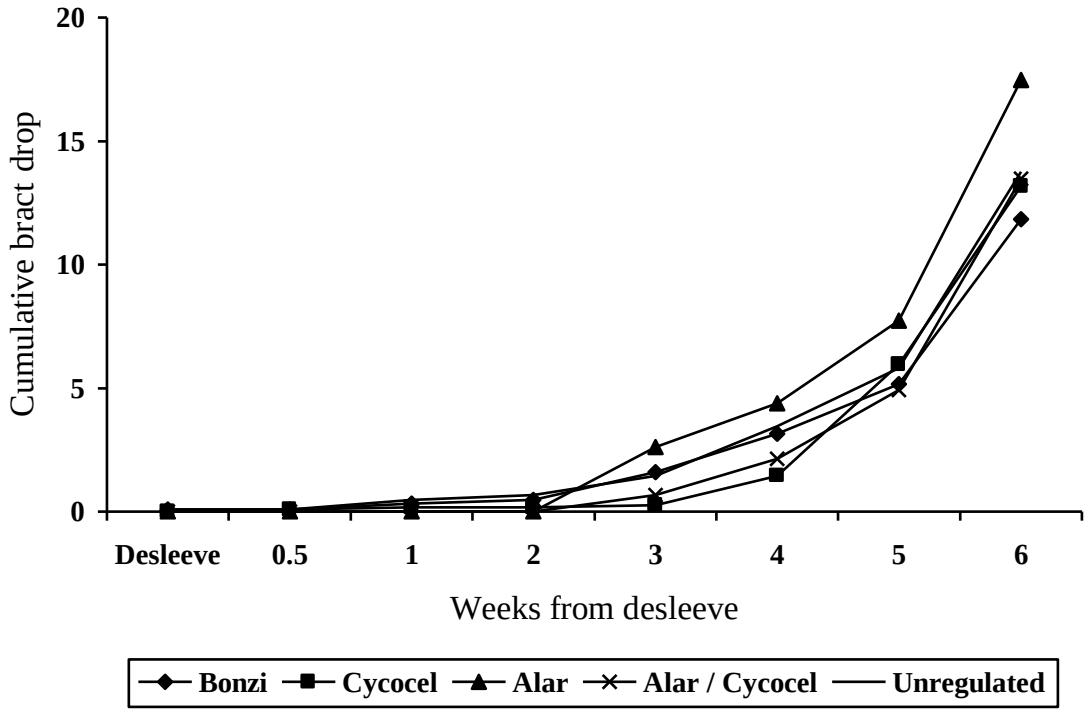
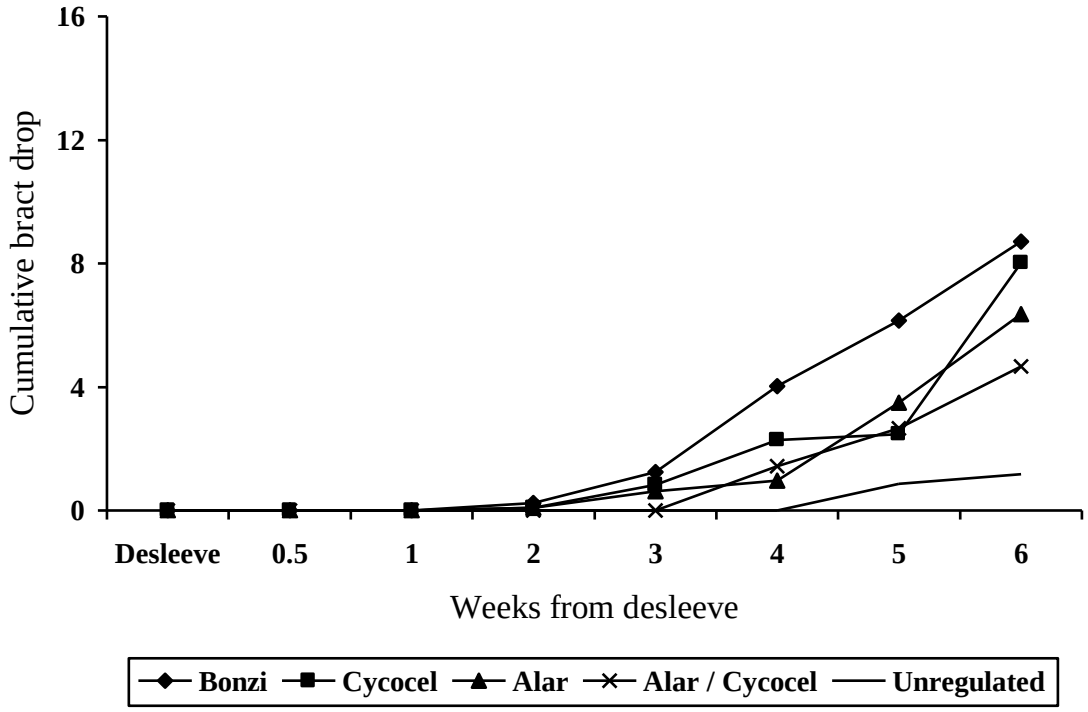
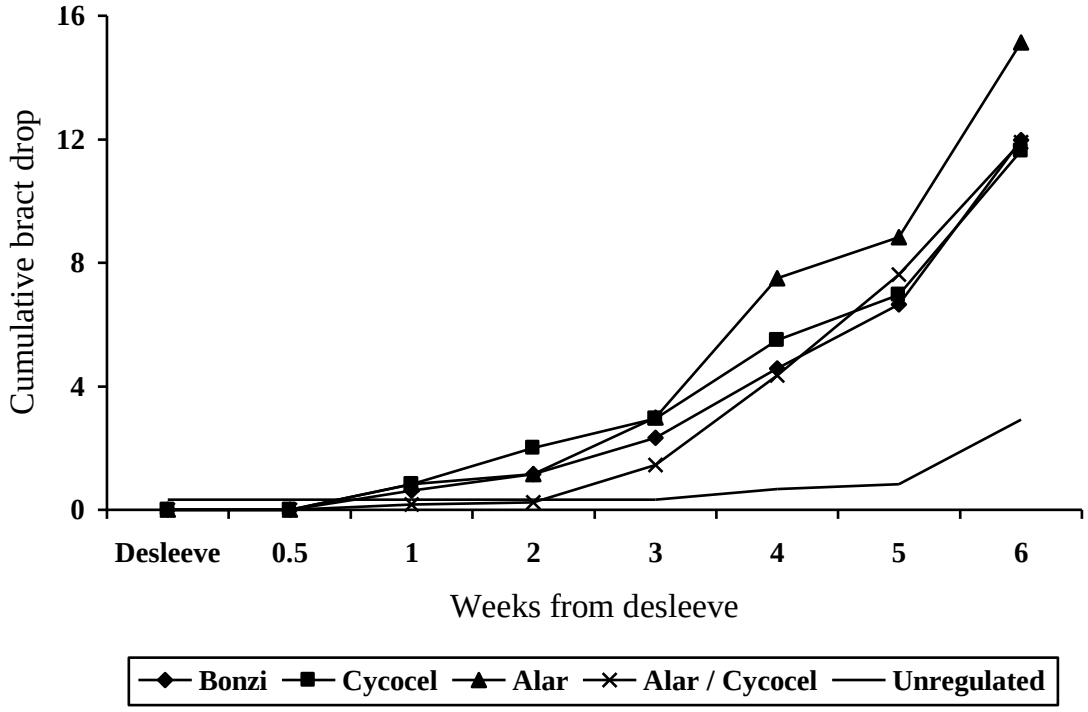


Figure 12: The cumulative bract drop of Sonora with each PGR in (a) standard and (b) DROP treatments.

a.



b.



Bracts tend to pale during shelf life, but in both years the use of DROP slowed this. DROP also tended to reduce bract necrosis and disease. The suggestion that DROP slows colour loss could be due to plants being grown cooler during production and being better adapted to fluctuating temperatures. In the first year there was a suggestion that bracts in DROP treatments were paler at the beginning of home life but this was not true in year 2.

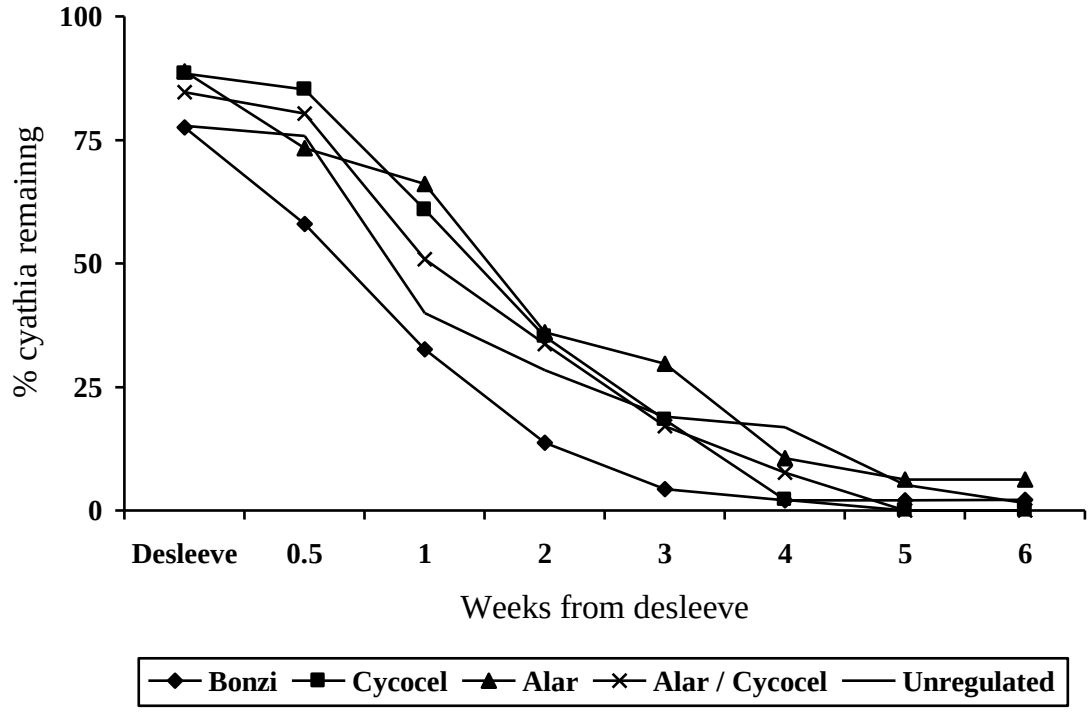
The loss of cyathia is a contentious issue. Some growers like varieties with large cyathia others would prefer very small cyathia that are not noticeable when lost. The loss of cyathia is often a reason for plants being returned and so it is a crucial post harvest variable. In general Sonora kept almost all of its cyathia for 3 weeks longer than Spotlight which looses cyathia very early (Figs 13 & 14). In year 1 DROP increased cyathia loss. In year 2 this was only true for the speed with which Spotlight lost its cyathia in weeks 1 and 2 of home life. Overall Spotlight still lost 100% of cyathia (Figure 13). Sonora appeared to hold its cyathia longer in the DROP compartment and tended to be more affected by PGRs (Fig 14).

In year 1 use of Bonzi increased the loss of cyathia. While this was true for Spotlight in the first week of home life in the 1999-2000 season, the main problem with Spotlight is that it looses all cyathia. Sonora showed that the addition of PGRs appeared to increase the time cyathia stayed on the plant. It is likely that the PGRs reduce the soft growth on a plant and so one would expect that the joints of stems are stronger on those plants that have not expended energy on soft growth.

The results on post harvest life of poinsettia demonstrate the importance of repeated experiments as they highlight the difficulties in generalisations from a single season's trial. Another factor that the work highlights is that although there are clear market specification that plants need to be grown to, little work has been carried out on what one should expect post harvest and indeed what level of post harvest performance increases the chance of a repeat purchase. How post harvest care effects home life performance is the subject of MAFF LINK work on robust product design. Whether supermarkets will begin to look at how home life affects sales remains to be seen, but growers may be best advised to continue to look closely at home life trials.

Figure 13: The % cyathia remaining of Spotlight with each PGR in (a) standard and (b) DROP treatments.

a.



b.

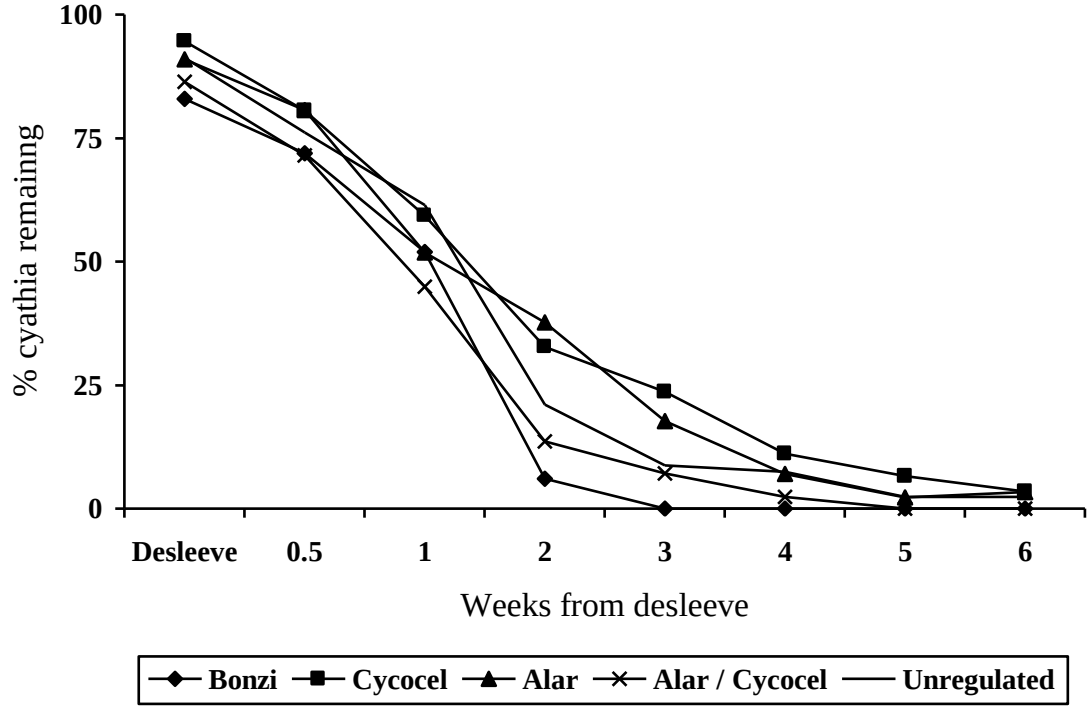
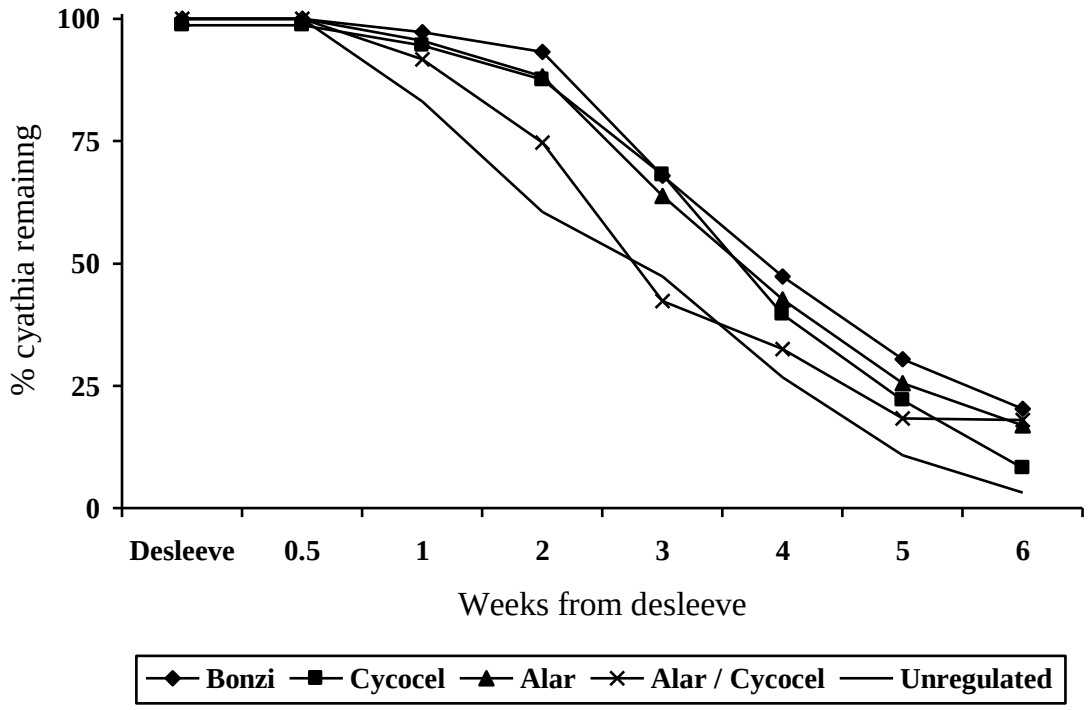
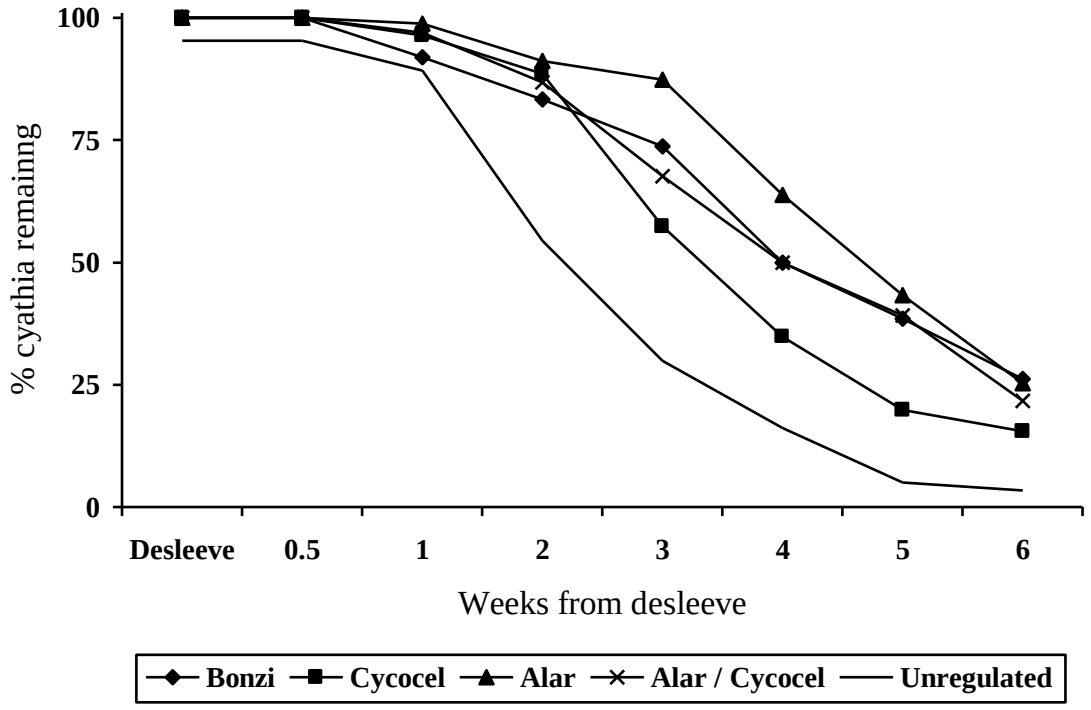


Figure 14: The % cyathia remaining of Sonora with each PGR in (a) standard and (b) DROP treatments.

a.



b.



2.5 *Conclusions*

- Sonora continues to increase in vigour relative to Spotlight, as has been the experience in recent years.
- The shorter response times of varieties under DROP are consistent, allowing a reduced response time to be used in a schedule.
- DROP increases the speed of response to initiation and appears to increase the evenness of response.
- DROP is an effective technique for height control and should be used as part of a normal DIF programme.
- The use of DROP reduces the numbers of PGR applications required.
- The early use of Bonzi can reduce the number of PGR applications significantly, giving a sharper response and a more uniform crop.
- Early PGR treatments may help to avoid late season stretch.
- Alar alone works as a PGR on poinsettia and has additive effects when mixed with cycocel.
- The cooler growing conditions under DROP tends to reduce leaf loss in shelf life.
- Interaction between DROP and different PGR's has been variable over the two years and requires further work.

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