Project Title	New cultivars of Poinsettia. Evaluation at marketing and in shelf life.
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Project leader:	Jill England, ADAS Boxworth
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Key staff:	Dr Jill England, ADAS, Project Leader Mr Harry Kitchener, Independent Consultant Andy Jukes, Warwick Crop Centre Mr Chris Dyer (ADAS) statistician
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[The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with 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.]

AUTHENTICATION

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

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GROWER SUMMARY

Headlines

- 'Infinity' performed consistently well when assessed at marketing and shelf life.
- 'Christmas Feeling' also performed well both at marketing and in shelf life, compared with 'Infinity', with the varieties 'Bravo Red', 'Christmas Day' and 'Christmas Beauty' all showing promise.

Background

An estimated four million poinsettia plants are grown in the UK annually. Poinsettia breeding programmes are continually producing promising new varieties, but they focus on the larger European and US markets rather than the UK. Performance of eleven varieties was evaluated under UK commercial production and environmental conditions to identify varieties that perform consistently well in the UK and to generate baseline data on their management.

Summary of the project and main conclusions

Data was collected from a range of poinsettia under evaluation at Hills Brothers, Chichester, West Sussex for Sainsbury's. Material was assessed for its performance at marketing and in shelf life, at Warwick Crop Centre, and compared in both instances with the industry standard variety, 'Infinity'. Growers were invited to make their own judgments at marketing and towards the end of the shelf life period at HDC/BPOA grower open days. The study focused on key indicators at marketing (including plant height, cyathia maturity and quality) and in shelf life (including leaf and bract drop, new growth and quality) with overall quality scores calculated at marketing and at the end of shelf life (
Table 1 and Table 2).

Eleven varieties were supplied by several breeding companies: Beekenkamp ('1070', 'Charon Red' and 'Saturnus'), Selecta ('Christmas Day', 'Christmas Feeling', 'Christmas Eve' and 'Christmas Beauty'), Syngenta ('Titan') and Dummen ('Prima Red', 'Bravo' and Protégé Dark Red'). The rooted cuttings, delivered in weeks 31 and 32, were managed according to the needs of the main commercial crop of 'Infinity' plants for marketing in week 48. 'Infinity' (Dummen) was included as a control for comparison. Plants were grown in 13cm pots at 18ºC (24 hrs) with nine plants/m^2. Plants were pinched in week 32 ('Saturnus', 'Charon Red', 'Prima Red' and 'Tita'n) and week 35 ('Infinity Red', 'Bravo', '1070', 'Christmas Beauty', 'Christmas Day', 'Christmas Feeling', 'Christmas Eve' and 'Protégé Red') in line with the commercial crop. Plant growth regulators were applied from week 35. Regular introductions of biological control agents were made to control aphid and whitefly.

Six plants of each variety were sleeved, boxed and transported to Warwick Crop Centre in week 49 for shelf life evaluation, designed to mimic supply chain conditions. The boxed plants

were kept closed for 5 days. Three plants of each variety were then placed on saucers and irrigated, to the saucer by hand as required to maintain growing media moisture, for a further 7 days before the sleeves were removed. The shelf life room temperature was set at 18°C ±1°C, relative humidity at 55-65%, and light (approximately 1000 lux, 1.5 W/m^2) was provided for 14 hours per day by fluorescent lights, positioned at plant height.

Marketing assessment

A quality assessment was made of 100 plants of each variety on 28 November 2012 (week 48), with 'Infinity' as the reference variety. The following scoring assessment was used: Class 1: four even heads of bracts at the top of the plant, strong even growth; Class 2: plants were slightly smaller, with less even growth and bract position, they did not have four even heads of bracts to the top of the plant, but were saleable and outgrade: plants exhibited weaker, uneven growth, two or less heads of bracts, generally considered unsaleable.

There were production issues on the nursery where energy/blackout screens were used between 16 September and 29 October 2012, putting the poinsettia into short days early and promoting flowering before the plants had reached the correct height. Comparison of the trial 'Infinity' plants with the main crop 'Infinity', which were not subjected to this treatment, indicated the effect of early short days. Bracts and leaves were smaller in the trial 'Infinity', and overall the plants were smaller; 95% of the main crop 'Infinity' were graded as Class 1, with 1% outgrades, when compared with the trial 'Infinity', where 55% of the plants were graded Class 1 and 11% outgrades. Although all of variety '1070' were outgrades, in light of the production issues, they were taken forward into shelf life assessment.

There were some clear differences in the quality of the trial varieties (Table 1). Plant quality ranged from 'Charon Red', the only variety with zero outgrades and 72% the plants evaluated as Class 1, to variety '1070', where all plants were considered outgrades. 'Charon Red', 'Prima Red' and 'Titan' all performed better at marketing compared with 'Infinity'. The majority of varieties were below the height specification (22-28 cm), and variety '1070' was not measured as they had all been assessed as outgrades. 'Charon Red' was the most vigorous variety. Performance may have been affected by the early short day treatment, with some varieties responding better than others to subsequent treatments to increase their height.

Cyathia were graded for maturity on a scale of 1-5, where 1 = tight green bud, 2 = bud colour, 3 = pollen showing, 4 = stigma open, 5 = pollen and stigma. Grades 2-3 were considered ideal at the point of marketing. The majority of cyathia scores were in the 2-3 range, suggesting the plants were of the correct maturity to perform well for the end consumer.

‘Christmas Feeling’ scored a borderline 1-2, but did maintain quality through shelf life. At grade 4, cyathia were considered more likely to drop during the dark transportation period, and at grade 5 they would be more prone to *Botrytis cinerea* infection. Variety ‘1070’ attained a cyathia score of 3-4.

Data were used to calculate an overall ranking for each variety. ‘Infinity’ (control) and ‘Prima Red’ ranked best overall at marketing, both being within the height specification, with few outgrades and a good cyathia score; both varieties achieved the maximum score of 3.0. ‘Charon Red’ achieved a lower score as the plants assessed were above the height specification, whilst other varieties achieved lower cyathia scores. Those plants that did not achieve the highest scores across the board may have been less mature than average and given more time their scores may have improved.

Table 1. Marketing assessment. Height specification: 22-28 cm. Cyathia scores: 1-2 = immature, 2-3 = ideal for marketing, 4 = more likely to drop during transportation, 5 = more prone to *Botrytis cinerea* infection. The overall ranked score was calculated based on quality, height and cyathia score. For more detail refer to the science section.

Variety (Response group)	Quality (%)			Height (cm)	Cyathia score	Overall ranking
	Class 1	Class 2	Outgrade			
‘Infinity’ – control (8.0)	55	34	11	23.4	2	3.0
‘Prima Red’ (7.5)	70	25	5	22.7	2-3	3.0
‘Charon Red’ (7.5/8/0)	72	28	0	29.0	2-3	2.7
‘Saturnus’ (7.5)	23	60	17	22.6	3-4	2.7
‘Christmas Feeling’ (7.5/8.0)	53	37	10	22.5	1-2	2.7
‘Titan’ (7.5/8.0)	62	31	7	21.5	2-3	2.7
‘Protégé Dark Red’ (7.5/8.0)	49	45	6	20.1	2-3	2.7
‘Christmas Day’ (7.5)	40	45	15	19.5	3-4	2.3
‘Christmas Eve’ (7.0)	45	37	18	20.4	2-3	2.3
‘Christmas Beauty’ (8.0)	29	47	24	18.3	2-3	2.3
‘Bravo Red’ (7.5)	38	48	14	17.6	2-3	2.3
‘1070’ (7.5/8.0)	0	0	100	-	3-4	1.3
Average	**55.0**	**38.0**	**9.0**	**21.0**	**2.6**	**1.3**

Shelf life assessment

The general condition of the poinsettia was assessed following five days of dark treatment. The majority were in good condition, although *Botrytis cinerea* was found on 13 plants (‘Saturnus’, ‘Christmas Beauty’, ‘Titan’, ‘Prima Red’, ‘Bravo Red’ and ‘Protégé Dark Red’). ‘Saturnus’ looked good whilst sleeved, but fell open and was no longer upright once the

sleeves were removed. ‘Christmas Day’ also fell slightly open, making a broader plant. ‘Infinity’ and ‘Prima Red’ both remained upright throughout.

Shelf life quality scores were allocated on a scale of 5-1 (5 = high quality, cyathia intact; 4 = good quality, some cyathia; 3 = acceptable quality, no cyathia; 2 = poor quality, no cyathia; 1 = end of shelf-life) using the same criteria as in project PC 156a to enable comparisons to be made. All plants were of adequate quality (score 3) or better at the start of shelf life (Table 2). After six weeks, scores ranged between 1.7 and 3.7. ‘Protégé Dark Red’ and ‘Saturnus’ were considered poor quality, scoring 1.7 and 2.0 respectively. Some marginal chlorosis was seen in one or two plants of ‘Titan’, ‘Saturnus’, ‘Protégé Dark Red’, ‘Bravo Red’, ‘Infinity’ and ‘Christmas Feeling’, generally on the lower leaves. A small amount of leaf marking occurred in one or two plants of ‘Charon Red’, ‘Prima Red’, ‘Protégé Dark Red’ and ‘Christmas Beauty’. Few cyathia were remaining on any varieties. ‘Infinity’ and ‘Bravo Red’ plants were still generally well clothed with leaves and bracts. ‘Prima Red’, ‘Titan’ and the Selecta ‘Christmas’ series also performed well.

A number of plants did not lose any leaves during shelf life: ‘Infinity’ (2 plants), ‘Christmas Feeling’ (2 plants), ‘Bravo Red’ (1 plant), ‘Prima Red’ (1 plant) and ‘Titan’ (1 plant). Least leaf drop was seen in ‘Christmas Feeling’, ‘Infinity’ and variety ‘1070’; greatest leaf drop was seen in ‘Saturnus’, ‘Charon Red’ and ‘Protégé Dark Red’ by the end of shelf life. However, generally, one plant of the three of each variety being tested performed poorly, dropping the majority of the leaves recorded for that variety (‘Christmas Eve’, ‘Protégé Dark Red’, ‘Saturnus’, ‘Prima Red’, ‘Christmas Beauty’ and ‘Infinity’). ‘Saturnus’ and ‘Protégé Dark Red’ lost leaves early and continued to degrade. Conversely, each of the three plants of ‘Christmas Day’ lost five leaves at the start of shelf life, but then stabilised with only three more leaves lost for that variety during the remainder of the trial.

Less than 50% of the plants dropped bracts and some varieties dropped none (‘Christmas Feeling’, variety ‘1070’ and ‘Christmas Beauty’). ‘Protégé Dark Red’, ‘Charon Red’ and ‘Saturnus’ performed least well, with one or two plants of each variety losing bracts at the start. One of the ‘Titan’ plants had lost two heads of bracts by the end of the trial.

New growth, detracting from the appearance of the poinsettia, was noted in some varieties (‘Saturnus’, ‘Christmas Day’, ‘Christmas Feeling’, ‘Christmas Eve’, ‘Christmas Beauty’ and ‘Protégé Dark Red’) at marketing and continued to develop in all varieties during the shelf life trial. New growth was scored on a scale of 1 to 3 (1 = slight, 2 = moderate, 3 = high) in the

final assessment at the end of the shelf life trial. 'Saturnus', 'Charon Red', 'Christmas Day' and 'Bravo Red' were the least affected at the end of shelf life.

Christmas Feeling

Bravo Red

Christmas Beauty

Infinity

Figure 1. Selection of Poinsettia at the end of shelf life

Data collected during the shelf life assessment were used to calculate an overall rank for each variety (Table 2). The varieties that ranked best overall at the end of shelf life were 'Infinity' and 'Bravo Red', closely followed by 'Christmas Feeling', 'Christmas Day' 'Christmas Beauty' and variety '1070'. Although all plants of variety '1070' were classed as outgrades at marketing, as the plants were less mature than required at this stage; they scored better during shelf life, losing few leaves or bracts and with a high quality score. 'Charon Red', 'Saturnus' and 'Protégé Dark Red' performed less well in shelf life, failing to achieve high scores in most categories. Varieties that performed well at marketing generally did not maintain their quality through the shelf life trial, the most notable exception was' Infinity' which scored well throughout and proved its position as the current industry standard. 'Christmas Feeling' also showed promise, scoring consistently well and maintaining quality throughout. 'Bravo Red' and variety '1070' in particular improved their scores relative to other varieties, having the lowest overall scores at marketing; 'Bravo Red' gained the same high score as

'Infinity' by the end of the trial. Conversely, 'Prima Red', 'Charon Red', and 'Saturnus' were all graded Class 1 at marketing, but fell to the bottom half of the ranking by the end of shelf life.

Some varieties did not respond well to the early use of energy/ blackout screens, which meant they were below the height specification at marketing, but they may have reached the height specification had the marketing date been delayed, and gone on to perform well during shelf life, as suggested by the overall quality score of variety '1070'.

Table 2. Scores at the end of shelf life: Leaf drop: '3' = 0 – 5 leaves, '2' = 6 – 10 leaves, '1' = > 10 leaves. Bract drop: '3' = 0 – 5 bracts, '2' = 6 – 10 bracts, '1' = > 10 bracts. New growth (±0.5): '3' = little new growth, '2' = moderate new growth, '1' = high level of new growth. Shelf life quality score: on a scale of 5-1 (5 = high quality, cyathia intact; 4 = good quality, some cyathia; 3 = acceptable quality, no cyathia; 2 = poor quality, no cyathia; 1 = end of shelf-life). The overall ranked score = average of scores across leaf and bract drop, new growth and shelf life performance (refer to science section for more detail).

Variety (Response group)	**Leaf drop**	**Bract drop**	**New growth**	**Shelf life quality**	**Overall rank**
'Infinity' – control (8.0)	3	3	2	4.0	3.0
'Bravo Red' (7.5)	3	3	3	3.0	3.0
'Christmas Feeling' (7.5/8.0)	3	3	2	3.0	2.8
'Christmas Day' (7.5)	2	3	3	3.0	2.8
'Christmas Beauty' (8.0)	3	3	2	3.0	2.8
'1070' (7.5/8.0)	3	3	2	3.0	2.8
'Titan' (7.5/8.0)	3	2	2	2.7	2.5
'Prima Red' (7.5)	3	3	1	2.7	2.5
'Christmas Eve' (7.0)	3	3	1	3.0	2.5
'Charon Red' (7.5/8.0)	2	1	3	2.7	2.3
'Saturnus' (7.5)	2	1	3	2.0	2.0
'Protégé Dark Red' (7.5/8.0)	2	1	2	1.7	1.8
Average	**4.7**	**5.2**	**1.9**	**2.6**	**2.6**

Financial benefits

The value of the UK grown poinsettia market is estimated at £8 million, of which 60-70% is Infinity. This trial provides growers with information on which poinsettia varieties are most likely to perform well under UK conditions, enabling growers to reduce costs by carrying out targeted in-house trials. Growers need to be confident that varieties are robust enough to withstand transportation, and retail storage and display, reducing costly wastage and returns from retailers. Shelf life evaluations provide useful information where growers do not have facilities to carry out their own evaluations.

Action points for growers

- In this trial, ‘Infinity’ proved that it is robust and capable of maintaining quality through marketing and shelf life, but growers should evaluate ‘Infinity’ with new varieties on their own holdings.
- Promising new varieties (e.g. ‘Bravo Red’, ‘Christmas Feeling’, ‘Christmas Day’ and ‘Christmas Beauty’) which may challenge ‘Infinity’ are coming through the breeding programmes, but they will need to be evaluated by growers on their own holdings.

SCIENCE SECTION

Introduction

An estimated 4 million poinsettia plants are grown in the UK annually, mainly in 13cm or 10cm pots. New varieties are required due to changing consumer demands and production systems. Poinsettia breeding programmes currently focus on the larger European and US markets rather than the UK. In this trial, performance was evaluated under UK commercial production and environmental conditions to identify those that performed consistently well and to generate baseline data on their management. A Poinsettia variety trial planned for the 2011 season was aborted due to *Bemesia tabaci* infestation, and rescheduled for 2012.

For this project, marketing data was collected from a range of material under evaluation at Hills Brothers, Chichester, West Sussex for Sainsbury's. Plant material was provided by the Poinsettia breeding companies. A sample of each variety was removed for shelf life evaluation at Warwick Crop Centre. Material was assessed for its performance at marketing and in shelf life, and compared in both instances with the industry standard variety, Infinity. The study was designed to focus on key indicators at marketing (height specification, cyathia maturity and quality) and shelf life (leaf and bract drop, secondary growth development and quality). Growers were invited to make their own judgments at marketing and towards the end of the shelf life period at Grower Open days.

Objectives

(i) Project aim(s):

To identify Poinsettia varieties suited to UK production.

(ii) Project objective(s):

Evaluate varieties of Poinsettia for their overall performance under UK production conditions through assessment of overall quality achieved at marketing and evaluation of plant deterioration in shelf life.

Method and materials

Eleven varieties (Table 3) were supplied to Hills Brothers as rooted cuttings in weeks 31 and 32 and managed according to the needs of the main commercial crop of largely Infinity plants for marketing in week 48; Infinity was included as a control for comparison. 100 plants of each variety were used for data collection. The plants were initially sited at the main Hill Brothers

site, and then moved to Stanley Nursery during week 42. Plants were grown in 13 cm pots at 18ºC (24 hrs) with 9 plants/m^2. Plants were pinched in week 32 (Saturnus, Charon Red, Prima Red, Titan) and week 35 (Infinity Red, Bravo, variety 1070, Christmas Beauty, Christmas Day, Christmas Feeling, Christmas Eve, Protégé Red) in line with the commercial crop. Plant growth regulators were applied from week 35 (Table 4).

Table 3. Poinsettia varieties evaluated

Breeder	Variety	Response group
Beekenkamp	1070	7.5/8.0
	Charon Red	7.5/8.0
	Saturnus	7.5
Selecta	Christmas Day	7.5
	Christmas Feeling	7.5/8.0
	Christmas Eve	7.0
	Christmas Beauty	8.0
Syngenta	Titan	7.5/8.0
Dummen	Prima Red	7.5
	Bravo	7.5
	Protégé Dark Red	7.5/8.0
	Infinity	8.0

Table 4. Plant growth regulation: dose rate (ml/100 L water) of Fargro Chlormequat (40% w/w) applied

Variety	Week No						No. applications
	35	36	37	38	41	42	
Titan	1.5	2.0	2.0	2.0	1.0	1.0	8
Saturnus	1.5	2.0	2.0	2.0	1.0	1.0	8
Charon Red	1.5	2.0	2.0	2.0	1.0	1.0	8
Bravo Red	1.5	2.0	2.0	1.5	1.0	1.0	7
Prima Red	1.5	2.0	2.0	2.0	1.0	1.0	8
1070	1.5	2.0	2.0	2.0	1.0	1.0	9
Infinity	1.5	2.0	2.0	1.5	1.0	1.0	7
Christmas Beauty	0	2.0	2.0	1.5	1.0	1.0	6
Christmas Day	0	2.0	2.0	1.5	1.0	1.0	6
Christmas Eve	0	2.0	2.0	1.5	1.0	1.0	6
Christmas Feeling	0	2.0	2.0	1.5	1.0	1.0	6
Protégé Dark Red	0	2.0	2.0	1.5	1.0	1.0	6

Substrate: Klasmann-Deilmann: white peat, (35%, 0.25 mm), white sod peat (30%, 10-25 mm), greenfibre (20%, medium), perlite (15%, coarse, 1-7.5 mm), clay granules (40 kg/m^3), PG Micro mix (trace elements, 1.0 kg/m^3) and K Hydro-S (Wetting Agent), pH 6.0.

Nutrition: Calcium nitrate (90.97 g/L), potassium nitrate (21.32 g/L), mono potassium phosphate (33.63 g/L), magnesium nitrate 50 g/L, Librel BMX (10 g/L)

Regular introductions of biological controls were made throughout production from week 35, to control Aphid (Aphiline Ace Mix - *Aphelinus abdominalis*, *Aphidius colemani*, *Aphidius ervi*) and Whitefly (Eretline-e and Encarline-f - *Eretmocerus eremicus* and *Encarsia Formosa* respectively).

Marketing

Plants were assessed at marketing (28 November 2012, week 48) for quality, cyathia maturity and height. A general assessment was also made of growth habit, vigour, sleevability, leaf cover, and bract, leaf and cyathia colour; the commentary is presented in Appendix 1.

Plant quality was assessed via a grade out into three classes (Figure 2), with Infinity as the reference variety:

- Class 1: plants had four even heads of bracts at the top of the plant, strong even growth.
- Class 2: plants were slightly smaller, with less even growth and bract position, they did not have four even heads of bracts to the top of the plant, but were saleable.
- Outgrade: plants exhibited weaker, uneven growth, two or less heads of bracts, generally considered unsaleable.

Cyathia were graded for maturity on a scale of 1-5, where 1 = tight green bud, 2 = bud colour visible, 3 = pollen visible, 4 = stigma open, 5 = pollen and stigma. Grades 2-3 were considered ideal at marketing.

Plant height was measured from the rim of the pot to the top of the plant and compared against the retailer height specification (22-28 cm). Scores achieved during the marketing assessments were graded into bands (**Error! Reference source not found.**) and used to calculate an overall quality score, with varieties ranked accordingly.

Figure 2. Plant quality grades at marketing, reference variety Infinity: Class 1 (left), Class 2 (centre) and Outgrade (right).

Table 5. Marketing assessment: grading bands used to calculate the ranked overall score in Table 9.

Plant quality[1]	*** = >55% Class 1 or 2	** = 10-55% Class 1 or 2	* = <9% Class 1 or 2
Plant quality[1]	*** = <10% Outgrades	** = 10-55% Outgrades	* = >55% Outgrades
Height	* = not measured	** = out of specification	*** = within specification
Cyathia score	* = cyathia score 1-2 & 5	** = cyathia score 3-4,	*** = cyathia score 2-3

[1]To calculate the ranked overall score shown in Table 9, the percentage of each variety that fell into each plant quality class (grade out %) was segregated into bands as above (Plant quality); they were averaged and calculated with height and cyathia scores to produce the ranked overall score.

Shelf life

Six plants of each variety were sleeved, boxed and transported to Warwick Crop Centre on 5 December 2012 (week 49) for shelf life evaluation. The boxed plants were kept closed for 5 days. Three plants of each variety were then placed on saucers and irrigated, to the saucer by hand as required to maintain growing media moisture, for a further 7 days before the sleeves were removed. The shelf life room temperature was set at 18°C ±1°C, and relative humidity at 55-65%. Light (approximately 1000 lux, 1.5 W/m^2) at plant height was provided for 14 hours per day by fluorescent lights.

After removing the sleeves, an initial assessment was carried out, followed by weekly assessments of leaf and bract drop, and plant quality. Plant quality was scored on a 5 to 1 scale (5 = high quality, cyathia still present; 4 = good quality, some cyathia still present; 3 = acceptable quality, no cyathia present; 2 = poor quality, no cyathia present; 1 = end of shelf-life); scores were allocated with reference to photographic records (Appendix 3) used for projects PC 156a and PC 279 to provide continuity. New growth developed on all Poinsettia

varieties during shelf life, and this was graded on a 1 to 3 scale (1 = slight, 2 = moderate, 3 = high). To further discriminate between varieties, plant quality, leaf drop, bract drop and new growth assessments were used to rank each variety (Table 5). To further discriminate between varieties, scores were separated into grading bands (Table 5), which were used to calculate an overall ranking for each variety at the end of shelf life.

Table 5. Shelf life assessment: grading bands used to calculate overall quality scores

Plant quality	Actual scores used		
Leaf drop	3 = 0 – 5 leaves	2 = 6 – 10 leaves	1 = > 10 leaves
Bract drop	3 = 0 – 5 bracts	2 = 6 – 10 bracts	1 = > 10 bracts
New growth	3 = 1 (±0.5) (score)	2 = 2 (±0.5) (score)	1 = 3 (±0.5) (score)

Results

On delivery at Hill Brothers, all cuttings were well rooted and of good quality. Plant height was generally even, with a few exceptions (Table 6), ranging between 4.2 and 8.1 cm, with an average of 5.5 cm.

Table 6. Initial cutting quality

Variety	**Comments**	**Height (cm)**
1070	Showing brakes	4.6
Charon Red	Height slightly uneven	5.9
Saturnus	Height slightly uneven	5.3
Christmas Day	Yellow leaves	5.0
Christmas Feeling	Yellow leaves	5.3
Christmas Eve	Yellow leaves	6.0
Christmas Beauty	Yellow leaves	5.5
Titan	Height slightly uneven	8.1
Prima Red	Thin stem	4.6
Bravo Red	Height slightly uneven	4.2
Protégé Dark Red	Yellow leaves	6.2
Infinity		5.7

All Poinsettia varieties included were assessed at marketing (week 48) and taken into shelf life. However, the results should be viewed in the context of production issues at Hills Brothers, when the energy/blackout screens were used between 16 September and 29 October 2012. This put the Poinsettia into short days early, promoting flowering before they had reached the correct height. To address this, the crop was provided with additional heat and 14 hour days from 30 September to 17 October.

Marketing assessment

Plant quality

A quality assessment (grade out) was made of 100 plants of each variety at week 48, by which time there were some clear differences in the quality of the trial varieties. Plant quality ranged from Charon Red, the only variety with zero outgrades and 72% of the plants evaluated as Class 1, to variety 1070, where all plants were considered outgrades as they were small and generally less mature compared with the majority of varieties (Figure 4, Appendix 2). Charon Red, Prima Red and Titan all performed better at marketing than the trial Infinity.

The effect of the Poinsettia being given short days too soon can be seen through comparison of trial Infinity plants with the main crop Infinity, which were not subjected to this treatment (Figure 3); bracts and leaves were smaller in the trial infinity, and overall the plants were smaller; 95% of the main crop Infinity were graded as Class 1, with 1% outgrades, whilst 55% of the trial Infinity were Class 1 with 11% outgrades.

Figure 3. Comparison of trial (left; note smaller bracts) and main crop (right) Infinity.

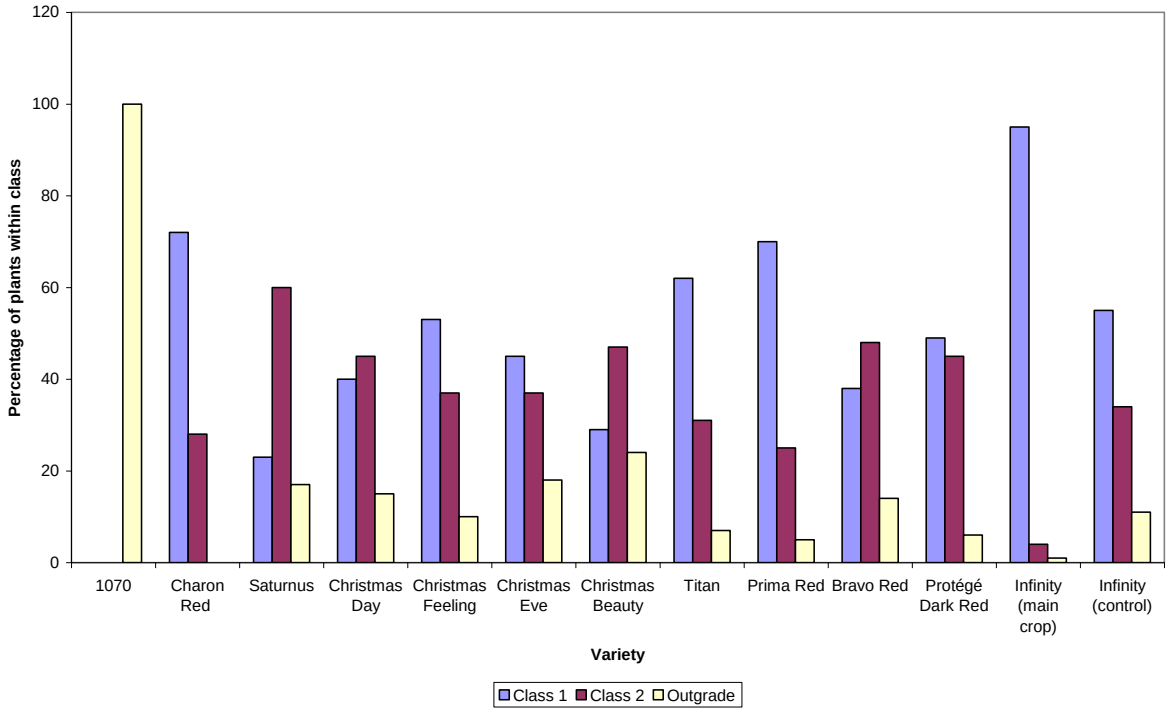

Figure 4. Marketing assessment: plant quality. Class 1 = 4 even heads of bracts; Class 2 = 4 or fewer heads of bracts, uneven; Outgrade = weak, uneven plants, unsaleable.

Plant height

The majority of varieties were below the height specification (22-28 cm), and variety 1070 was not measured as they had all been assessed as outgrades (Figure 5). Charon Red was the most vigorous variety. Performance may have been affected by the early short day treatment, with some varieties responding better than others to subsequent treatments to increase their height.

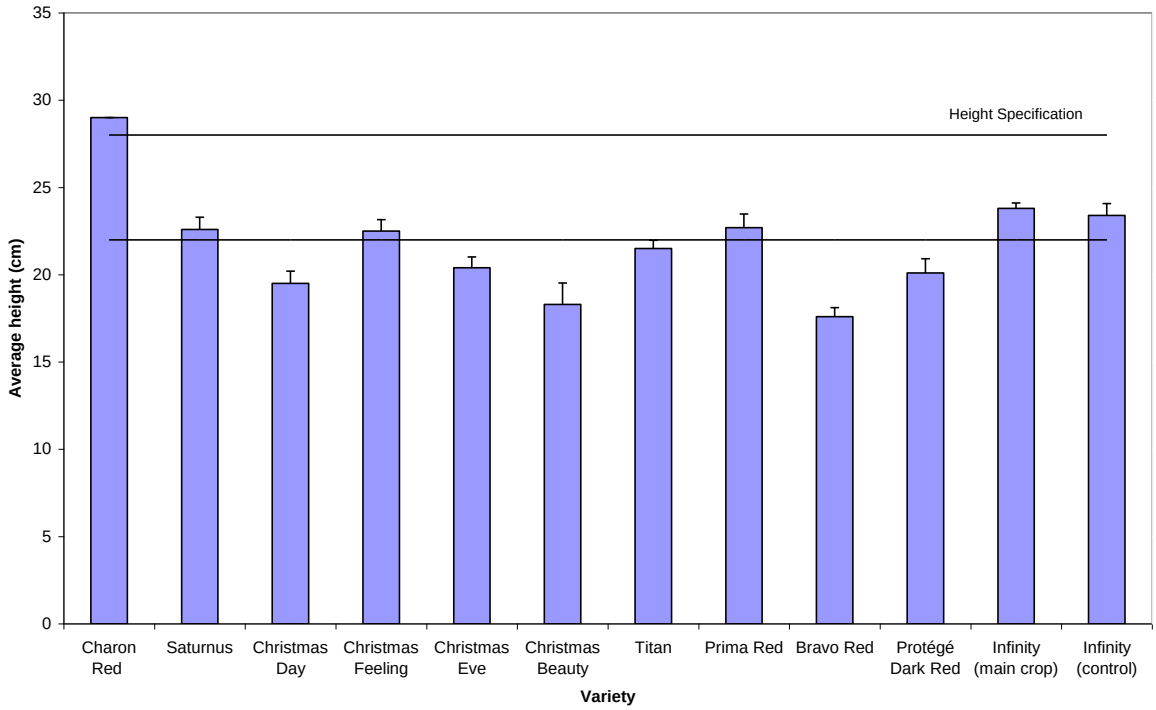

Figure 5. Marketing assessment: average plant height (cm). Height specification: 22-28 cm. Variety 1070 was not measured.

Cyathia scores

The majority of cyathia scores were in the 2-3 range (Table 7), suggesting the plants were of the correct maturity to perform well for the consumer. Christmas Feeling scored a borderline 1-2, but did maintain quality through shelf life (**Error! Reference source not found.**). At grade 4, cyathia were considered more likely to drop during the dark transportation period, and at grade 5 they would be more prone to *Botrytis cinerea* infection. Although variety 1070 plants were generally small, they attained a cyathia score of 3-4.

Table 7. Marketing assessment: cyathia scores: 1 = tight green bud, 2 = bud colour, 3 = pollen showing, 4 = stigma open, 5 = pollen and stigma.

Variety	Score	Variety	Score
1070	3-4	Christmas Beauty	2-3
Charon Red	2-3	Titan	2-3
Saturnus	3-4	Prima Red	2-3
Christmas Day	3-4	Bravo Red	2-3
Christmas Feeling	1-2	Protégé Dark Red	2-3
Christmas Eve	2-3	Infinity (control)	2

Quality overview

Data collected during the marketing assessment were graded into bands (**Error! Reference source not found.**) and used to calculate an overall rank for each variety (Table 8). The varieties that ranked best overall at marketing were Prima Red and Infinity (control), both

being within the height specification, with few outgrades and a good cyathia score; both varieties achieved the maximum score of 3.0. Charon Red achieved a lower score as the plants assessed were above the height specification, whilst other varieties achieved lower cyathia scores. Those plants that did not achieve the highest scores across the board may have been less mature than average and given time their scores may have improved; however scores did not correlate with response group.

Table 8. Marketing assessment. Grade out % denotes the proportion of plants within each class. Height specification: 22-28 cm. Cyathia scores: 1-2 = immature, 2-3 = ideal for marketing, 4 = more likely to drop during transportation, 5 = more prone to *Botrytis cinerea* infection. [1]To calculate the average of the grade out scores, the percentage of each variety that fell into each plant quality class (grade out %), height and cyathia scores was segregated into bands (refer to Table 5 for banding details), denoted by asterisks in the table, which were then averaged and calculated with height and cyathia scores to produce the ranked overall score.

Variety (Response group)	Grade out (%)			Ave. of grade out score[1]	Height (cm)	Cyathia score	Ranked overall score
	Class 1	Class 2	Outgrade				
Prima Red (7.5)	*** 70	** 25	*** 5	*** 2.7	*** 22.7	*** 2-3	3.0
Infinity – control (8.0)	*** 55	** 34	** 11	*** 2.3	*** 23.4	*** 2	3.0
Charon Red (7.5/8/0)	*** 72	** 28	*** 0	*** 2.7	** 29	*** 2-3	2.7
Saturnus (7.5)	* 23	*** 60	** 17	*** 2.0	*** 22.6	** 3-4	2.7
Christmas Feeling (7.5/8.0)	** 53	** 37	** 10	*** 2.0	*** 22.5	** 1-2	2.7
Titan (7.5/8.0)	*** 62	** 31	*** 7	*** 2.7	** 21.5	*** 2-3	2.7
Protégé Dark Red (7.5/8.0)	* 49	** 45	*** 6	*** 2.0	** 20.1	*** 2-3	2.7
Christmas Day (7.5)	** 40	** 45	** 15	*** 2.0	** 19.5	** 3-4	2.3
Christmas Eve (7.0)	* 45	** 37	** 18	** 1.7	** 20.4	*** 2-3	2.3
Christmas Beauty (8.0)	* 29	** 47	** 24	** 1.7	** 18.3	*** 2-3	2.3
Bravo Red (7.5)	* 38	** 48	** 14	** 1.7	** 17.6	*** 2-3	2.3
1070 (7.5/8.0)	* 0	* 0	* 100	* 1.0	* -	** 3-4	1.3
Average	**55.0**	**38.0**	**9.0**	**2.0**	**21.0**	**2.6**	1.3

Shelf life assessment

Images of all plants subjected to shelf life evaluation were taken during the final shelf life assessment and are presented in (Appendix 4**).** The general condition of plants was assessed following five days dark treatment (Table 9). The majority were in good condition, although *Botrytis cinerea* was found on 13 plants. Saturnus looked good whilst sleeved, but fell open and was no longer upright once the sleeves were removed. Christmas Day also fell slightly open, making a broader plant. Infinity and Prima Red both remained upright throughout.

Table 9. Plant condition after five days dark treatment

Variety	Plant condition
1070	All good
Charon Red	All good
Saturnus	*Botrytis cinerea* on 3 plants
Christmas Day	All good
Christmas Feeling	All good
Christmas Eve	All good
Christmas Beauty	*Botrytis cinerea* on 1 plant
Titan	*Botrytis cinerea* on 1 plant, 1 plant scorched
Prima Red	*Botrytis cinerea* on 2 plants
Bravo Red	*Botrytis cinerea* on 3 plants
Protégé Dark Red	*Botrytis cinerea* on 3 plants
Infinity	All good

Quality score

Quality scores were allocated with reference to images used in project PC 156a (Appendix 3). All plants were of adequate quality (score 3) or better at the start of shelf life. After six weeks, scores ranged between 1.7 and 3.7. Protégé Dark Red and Saturnus were considered poor quality, scoring 1.7 and 2.0 respectively, and this is reflected in the images presented in Appendix 4, where leaves and bracts are sparse in these varieties. Some marginal chlorosis was seen in 1-2 plants of Titan, Saturnus, Protégé Dark Red, Bravo Red, Infinity and Christmas Feeling, generally on lower leaves. A small amount of leaf marking occurred in one or two plants of Charon Red, Prima Red, Protégé Dark Red and Christmas Beauty. Few cyathia were remaining on any varieties. Infinity and Bravo Red plants were still generally well clothed with leaves and bracts. The Prima Red, Titan and the Selecta 'Christmas' series also performed well.

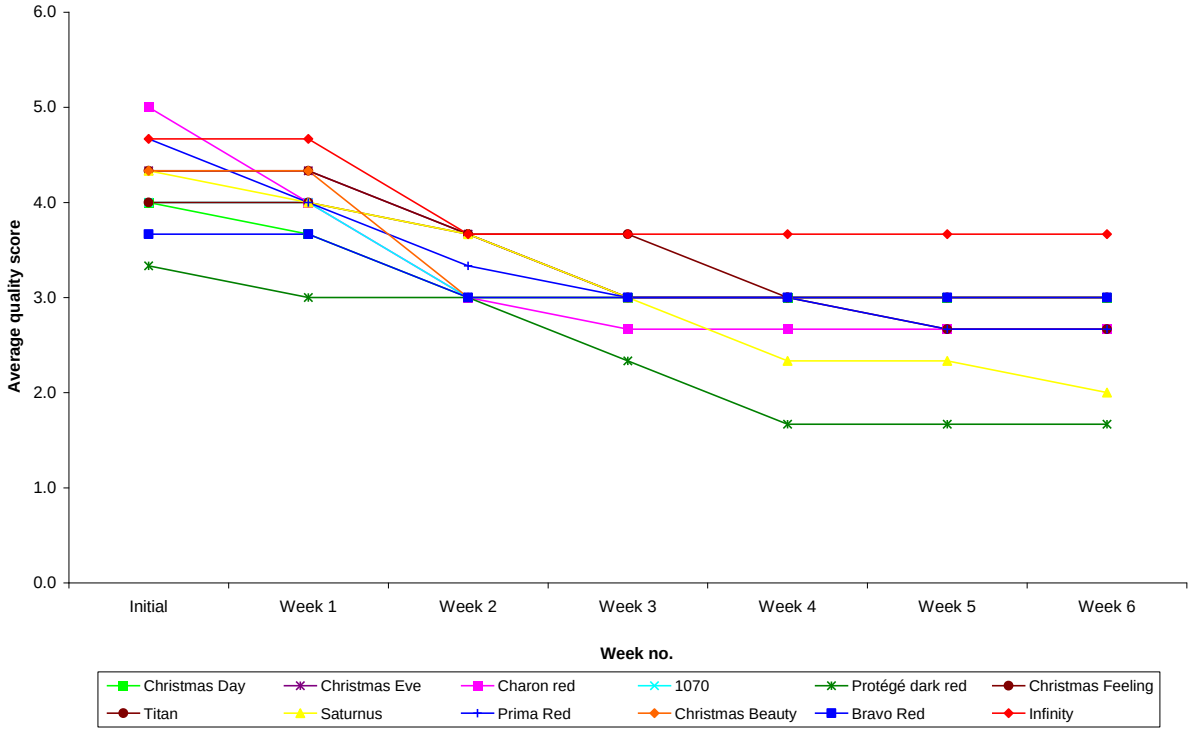

Figure 6. Shelf life assessment: average quality score: 5 = high quality, cyathia intact; 4 = good quality, some cyathia; 3 = acceptable quality, no cyathia; 2 = poor quality, no cyathia; 1 = end of shelf-life). Refer to reference images.

Leaf drop

A number of plants did not lose any leaves during shelf life: Infinity (2 plants), Christmas Feeling (2 plants), Bravo Red (1 plant), Prima Red (1 plant) and Titan (1 plant) (Figure 7). Least leaf drop was seen in Christmas Feeling, Infinity and variety 1070; greatest leaf drop was seen in Saturnus, Charon Red and Protégé Dark Red by the end of shelf life. However, generally, one plant of the three of each variety being tested performed poorly, dropping the majority of the leaves recorded for that variety (Christmas Eve, Protégé Dark Red, Saturnus, Prima Red, Christmas Beauty and Infinity). Saturnus and Protégé Dark Red lost leaves at the start of shelf life and continued to do so throughout the evaluation. Conversely, each of the three plants of Christmas Day lost five leaves at the start of shelf life, but then stabilised with only three more leaves lost for that variety during the remainder of the evaluation.

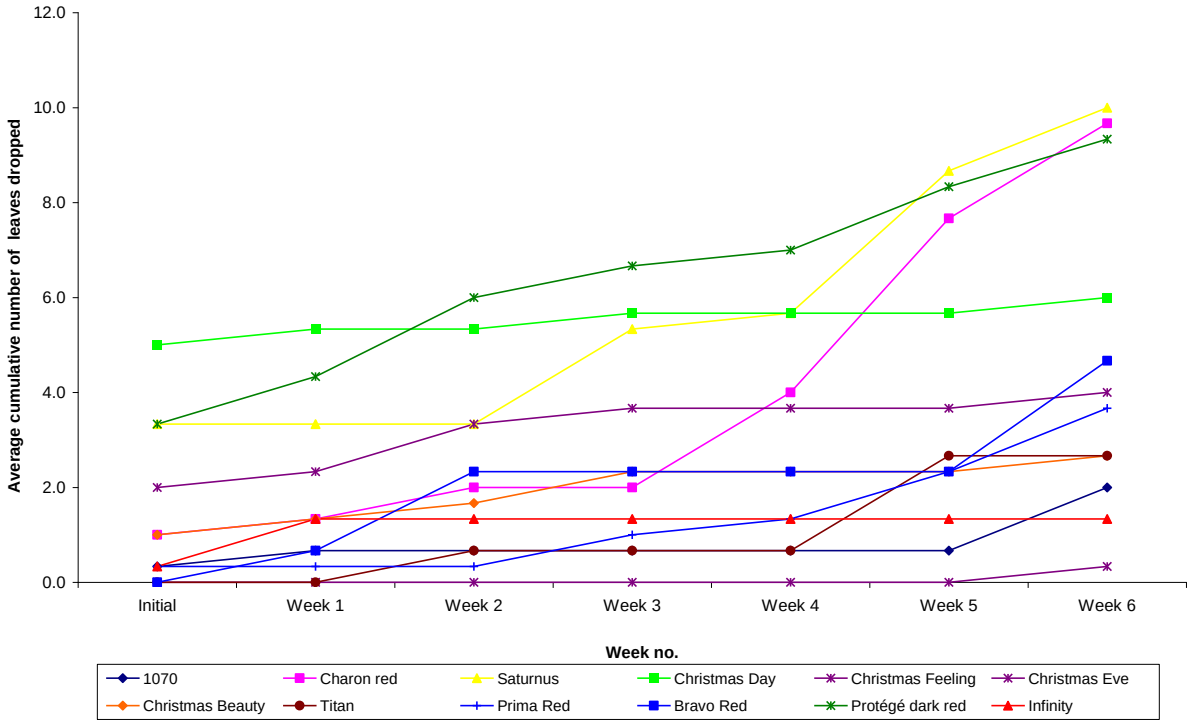

Figure 7. Shelf life assessment: average cumulative number of leaves dropped during shelf life.

Bract drop

Less than 50% of the plants dropped bracts and some varieties dropped none (Christmas Feeling, variety 1070 and Christmas Beauty) (Figure 8). Protégé Dark Red, Charon Red and Saturnus performed least well, with one or two plants of each variety losing bracts at the start. One of the Titan plants had lost two heads of bracts by the end of the trial (Appendix 4).

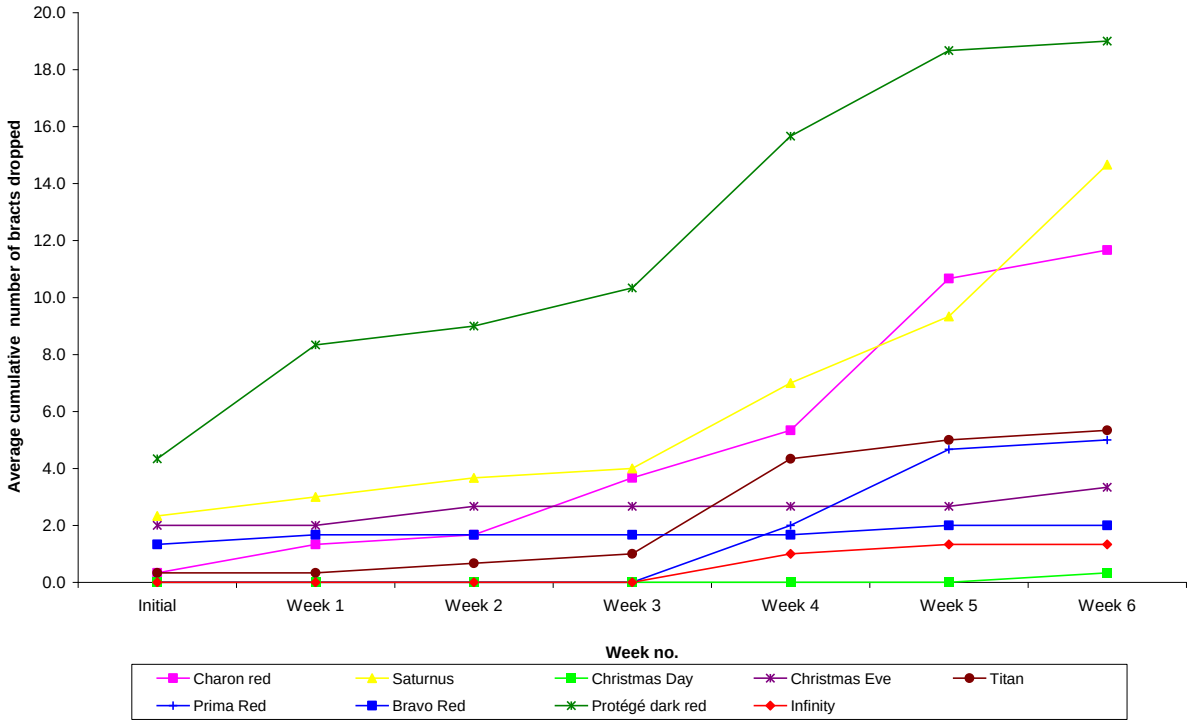

Figure 8. Shelf life assessment: average cumulative number of bracts dropped during shelf life. Neither Christmas Feeling, Christmas Beauty nor 1070 dropped any bracts and are not included in this graph.

New growth (Figure 9 and Figure 10), detracting from the appearance of the poinsettia, was noted in some varieties ('Saturnus', 'Christmas Day', 'Christmas Feeling', 'Christmas Eve', 'Christmas Beauty' and 'Protégé Dark Red') at marketing and continued to develop in all varieties during the shelf life trial. New growth was scored on a scale of 1 to 3 (1 = slight, 2 = moderate, 3 = high) in the final assessment at the end of the shelf life trial. 'Saturnus', 'Charon Red', 'Christmas Day' and 'Bravo Red' were the least affected at the end of shelf life.

Figure 9. New growth scores: 1 = slight (left); 2 = moderate (centre); 3 = high (right), detracting from plant quality

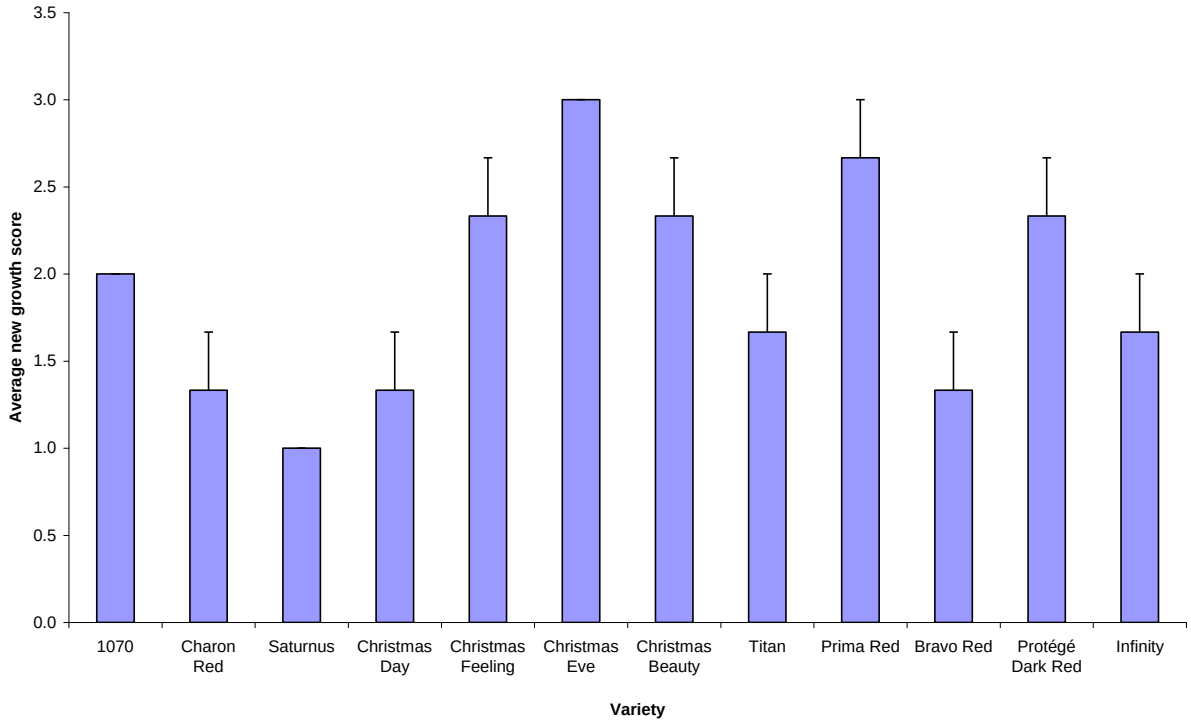

Figure 10. Shelf life assessment: new growth scores: 1 = slight, 2 = moderate, 3 = high, detracting from plant quality

Overall rank

Data collected during the shelf life assessment were graded into bands (Table 5) and used to calculate an overall rank for each variety (**Error! Reference source not found.**). The varieties that ranked best overall at the end of shelf life were Infinity and Bravo Red, closely followed by Christmas Feeling, Christmas Day Christmas Beauty and variety 1070. Although all plants of variety 1070 were below the height specification at marketing and therefore classed as outgrades, they scored better during shelf life, losing few leaves or bracts and had a high quality score; this variety did show some potential, but only if the height could be managed economically. Charon Red, Saturnus and Protégé Dark Red performed less well in shelf life, failing to achieve high scores in most categories.

Table 10. Scores at the end of shelf life: Leaf drop: '3' = 0 – 5 leaves, '2' = 6 – 10 leaves, '1' = > 10 leaves. Bract drop: '3' = 0 – 5 bracts, '2' = 6 – 10 bracts, '1' = > 10 bracts. New growth (±0.5): '3' = little new growth, '2' = moderate new growth, '1' = high levels of new growth. Shelf life quality score: on a scale of 5-1 (5 = high quality, cyathia intact; 4 = good quality, some cyathia; 3 = acceptable quality, no cyathia; 2 = poor quality, no cyathia; 1 = end of shelf-life). Ranked overall score = average of scores across leaf and bract drop, new growth and shelf life performance. For more detail on the bandings used, refer to Table 6.

Variety (Response group)	**Leaf drop**	**Bract drop**	**New growth**	**Shelf life quality**	**Overall rank**
'Infinity' – control (8.0)	3	3	2	4.0	3.0
'Bravo Red' (7.5)	3	3	3	3.0	3.0
'Christmas Feeling' (7.5/8.0)	3	3	2	3.0	2.8
'Christmas Day' (7.5)	2	3	3	3.0	2.8
'Christmas Beauty' (8.0)	3	3	2	3.0	2.8
'1070' (7.5/8.0)	3	3	2	3.0	2.8
'Titan' (7.5/8.0)	3	2	2	2.7	2.5
'Prima Red' (7.5)	3	3	1	2.7	2.5
'Christmas Eve' (7.0)	3	3	1	3.0	2.5
'Charon Red' (7.5/8.0)	2	1	3	2.7	2.3
'Saturnus' (7.5)	2	1	3	2.0	2.0
'Protégé Dark Red' (7.5/8.0)	2	1	2	1.7	1.8
Average	**4.7**	**5.2**	**1.9**	**2.6**	**2.6**

Conclusions

Varieties that performed well at marketing generally did not maintain their quality through the shelf life trial, the most notable exception was Infinity which scored well throughout and proved its position as the current industry standard variety. Some of the varieties tested may challenge Infinity, but they will need to be evaluated by growers on their own holdings. Christmas Feeling showed particular promise, scoring consistently well and maintaining quality at both the marketing assessment and at the end of shelf life. Other varieties that showed promise at the end of shelf life were Christmas Day and Christmas Beauty. Bravo Red and variety 1070 in particular improved their scores relative to other varieties having the lowest overall scores at marketing; Bravo Red gained the same high score as Infinity by the end of shelf life.

Conversely, Prima Red, Charon Red, and Saturnus were all graded Class 1 at marketing, but fell to the bottom half of the ranking by the end of shelf life. The early promise shown by Charon Red, Protégé Dark Red and Saturnus at marketing did not come through in this shelf life trial.

Whilst some varieties were below the height specification at marketing, this may be a reflection of the production issues experienced on the nursery, and with a later marketing date they may have reached the height specification and performed well during shelf life, as suggested by the overall quality score of variety 1070.

These results do need to be considered in the context of the production issues experienced on the nursery, therefore - in part at least - they are a measure of how robust the varieties are and how well the plants recovered from these growing conditions.

Technology transfer

- Grower open day, Hill Brothers Nursery, November 2012
- Grower open day, Warwick Crop Centre, January 2013
- Final report, March 2013

References

PC 156a - Poinsettia: an assessment of the marketing and shelf-life quality of new varieties and selections grown under commercial conditions.

PC 279 - Poinsettia: Commercial evaluation of new varieties and investigation of consumer preferences.

Acknowledgments

Our thanks go to Hill Brothers for permitting access to their crop - for assessments and the Grower Open Day, and for providing plants for the shelf life trial and for allowing us to publish their production information.

Appendix 1. Notes on Poinsettia varieties at marketing

Variety: 1070 Breeder: Beekenkamp Response group: 7.5/8.0

Bracts mainly immature, oval, deep red. Cyathia on many plants, stage 3/4. Leaves dark, oval shaped.

Variety: Charon Red Breeder: Beekenkamp Response group: 7.5/8.0

Bracts bright red with a touch of blue and a tendency to be oval. Some vein darkening. Cyathia large, but stage 2/3. Leaves dark green, appearing oval. Habit upright and vigorous. Harvest in 7 to 10 days. Looks well in a bag; strong and easy to sleeve with leaves to the base.

Variety: Christmas Day Breeder: Selecta Response group: 7.5

Bracts bright red, however some darker areas in bracts with slight blueing. Bracts oval. Cyathia prominent, red yellow, stage 3/4. Leaves tending towards oak leaf type. Upright habit. Secondary growth present. Some height variation (a difference of 7cm between the shortest and tallest plants. Some secondary growth.

Variety: Christmas Feeling Breeder: Selecta Response group: 7.5/8.0

Bracts dark red with a slight blueish tinge and some black veins. Cyathia small, stage 1/2. Leaves dark green, oval. Leaves close to the bracts and covering them on some plants. Upright habit. Some secondary growth.

Variety: Christmas Eve Breeder: Selecta Response group: 7.0

Bracts dark rose red, a little blue with some darker veins; oval shaped. Cyathia prominent, stage 2/3. Leaves dark green. Upright habit. Some secondary growth. Some variation in height.

Variety: Christmas Beauty Breeder: Selecta Response group: 8.0

Bracts bright pinkish red with darker veins; oval shaped. Leaves dark green. Cyathia stage 2/3. Vigorous. Some secondary growth.

Variety: Titan Breeder: Syngenta Response group: 7.5/8.0

Bracts bright red with slightly darker veins; tendency towards oval shape. Cyathia stage 2/3. Leaves dark green and to the base of the plant.

Variety: Saturnus Breeder: Beekenkamp Response group: 7.5

Bracts bright red, good colour, oval with some oak leaf form. Cyathia large, stage 3/4. Leaves dark green, oak leaf to oval shape. Plants appear to be on a leg. Some secondary growth. Meets the grade in part, but not an even sample, as the grade out shows. Possibly due to too early initiation, hard material or low temperatures for the variety.

Variety: Prima Red Breeder: Dummen Response group: 7.5

Bracts bright red with slight blueing. Oval shape with slight darker veins. Cyathia prominent red/yellow, stage 2/3. Upright habit. Leaves dark green and to the base.

Variety: Bravo Red Breeder: Dummen Response group: 7.5

Bracts rose red; lower bracts showing green with a slight yellow and a tendency towards oak leaf type. Leaves dark green, oak leaved. Cyathia large, stage 2/3. Vigour was poor this crop.

Variety: Protégé Dark Red Breeder: Dummen Response group: 7.5/8.0

Bracts with slight pink colouration in the red, some black veins, some blue. Slight tendency to oak leaf bract shape. Leaves a slightly lighter green. Cyathia stage 2/3. Some secondary growth.

Variety: Infinity (control) Breeder: Dummen Response group: 8.0

Bracts dark red, some with a blue tinge; mainly oval shaped. Cyathia small, stage 2/3. Leaves dark green and clean. Upright habit.

Variety: Infinity (main crop) Breeder: Dummen Response group: 8.0

Bracts dark red some blue but full. Cyathia slightly smaller than the trial Infinity, stage 2. Habit upright.

Appendix 2. Plant quality classes for each Poinsettia variety at marketing (Class 1, left; Class 2, centre; Outgrade, right)

1070 (all outgrades)

Charon Red

Saturnus

Christmas Day

Christmas Feeling

Christmas Eve

Christmas Beauty

Titan

Prima Red

Bravo Red

Protégé Dark Red

Infinity

Appendix 3. Shelf life quality score reference images (ref. PC 156a)

5. Bracts and leaves good colour and no marks. Cyathia large and yellow

4. Bracts good colour, slight leaf marginal chlorosis, slight lower stem defoliation

3. Bract colour good, but slight fading. Slight leaf colour change and cyathia abortion

3. Faded bract colour, some discoloured and puckering. Leaves discolouring with increased marginal chlorosis

1. Bracts faded and discoloured. Leaves mottled. All cyathia aborted.

0. Bracts faded and discoloured. Many bracts, leaves and cyathia have dropped.

0. The whole plant wilted

Appendix 4. Poinsettia by variety at the end of shelf life

1070

Charon Red

Saturnus

Christmas Day

Christmas Feeling

Christmas Eve

Christmas Beauty

Titan

Prima Red

Bravo Red

Protégé Dark Red

Infinity