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Location of project:	The University of Lincoln
Industry Representative:	Mike Opperman, Oppermans Plants, Spalding
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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.

Simon Pearson, Professor of Agri-Food Technology

The University of Lincoln

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CONTENTS

GROWER SUMMARY

Headline

This trial has highlighted several new poinsettia varieties of significant commercial interest; these include Hera Red, No 57, Astro Red; all benchmarked well and were at least equivalent to Infinity 2.0 the main commercial variety. The trial has also shown wicks and water pads can extend shelf life (retail store phase) by five to eight days.

Background and expected deliverables

Poinsettias are one of the key UK pot plant product lines. To date the industry has relied on a relatively small number of key varieties to meet the needs of supermarkets and multiple retailers. There have been recent concerns that some of the well-established varieties might have become less reliable. The AHDB/BPOA Poinsettia study tour to the Netherlands in 2014 also highlighted a number of new varieties that might be about to enter the market that have potential for cultivation in the UK for these markets. The selection of poinsettia varieties to grow is an important key decision for all pot and bedding plant growers. These decisions are usually made by viewing the varieties at plant breeders open days, on other nurseries and in consultation with colleagues, breeders, customers and peers. It is not clear though whether varietal performance is reliably consistent between all growers, or whether particular varieties suit or are well adapted to the cultivation techniques and facilities used by specific growers. If varieties perform consistently across all growers and facilities, then selection might be simplified as overall performance would be robust across a wide range of circumstances. The aims of this project were to test on a range of different nurseries various new poinsettia varieties, benchmarked against classical commercial controls (12 old and new varieties were tested in total). These varieties were grown across three different sites in the UK to test variety resilience across sites and environmental conditions. Furthermore, all plants were subjected to shelf life testing at the University of Lincoln and a number of irrigation aid treatments were examined to determine their impact on product shelf life.

Summary of the work and main conclusions

The growers who supported the trial by growing the crops were Pinetops Nurseries (Hampshire), Delamore Young Plants (Cambridgeshire) and KRN House and Garden Plants (Lincolnshire).

The varieties tested, from a number of different plant breeders, included (the relevant flowering response time in weeks is provided for each in brackets):

- **Beekenkamp:** Astro Red (7.5 wks), Hera Red (8.5 wks), Pallas Red (7.5 wks) and No 57 (an experimental variety, one grower only and plants received two weeks later than the initial batch).
- **Dummen:** Infinity 2.0 (8 wks), Matinee Bright Red (8 wks), Maxima (8 wks) and Prima Donna (8 wks).
- **Selecta:** Christmas Eve (7.5 wks) (8.5 wks), Christmas Feeling (8.5 wks), Happy Day (8.5 wks).
- **Syngenta:** Neva (8 wks).

During shelf life assessment the impact of different shelf life extension products (Pokon Aqua Pad Standard, a water absorbent pad and Aqua Pad wrapped, a wick based system) were also examined on overall plant quality.

Upon receipt of the crop (22 November 2015) at the University of Lincoln from the commercial sites, plants from one nursery were significantly more advanced than the others (by around two weeks). From the crop records supplied, there were also significant differences in approaches to the use of PGR's to control crop growth and development, one nursery had made five applications of chlormequat compared with up to 13 by another. The overall quality scores at the point of harvest are summarised in the Figure 1 below.

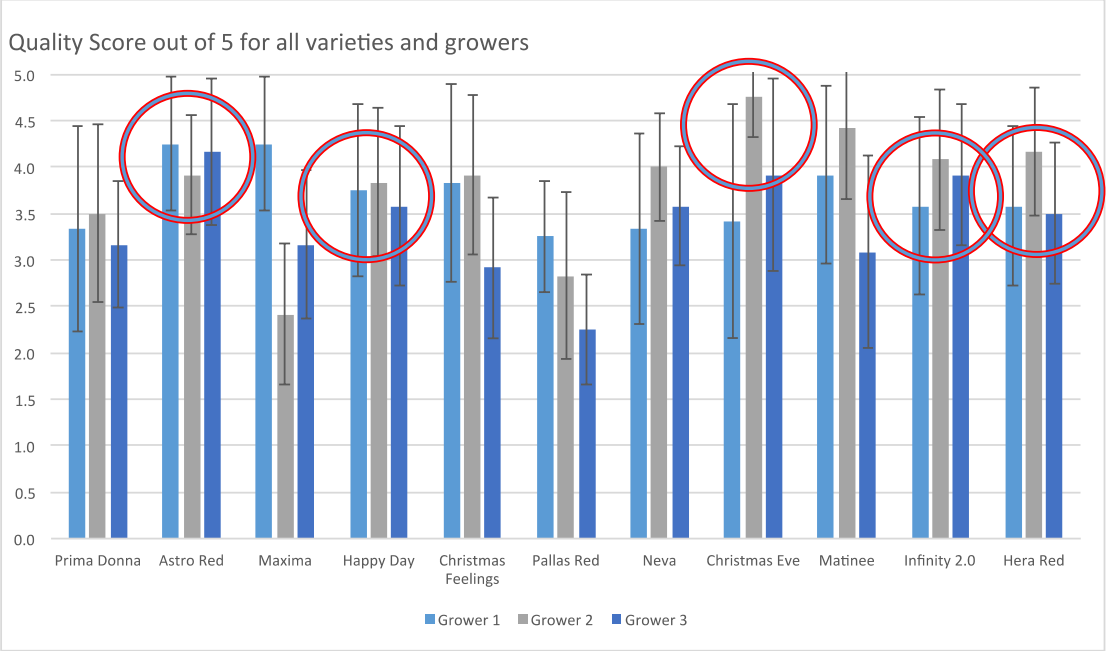

Figure 1. Quality scores for each variety from each nursery at the point of harvest

The data showed that Astro Red, Christmas Eve, Happy Day, Hera Red and Infinity 2.0, achieved the highest, consistent quality scores. There were some significant interactions between nursery and variety, for example Maxima performed very well at grower 1, but was judged to be poor at grower 2. After the plants were harvested a sub-sample were subjected to a full shelf life analysis at the University of Lincoln. The final quality scores at the end of post harvest are summarised in Figure 2 below.

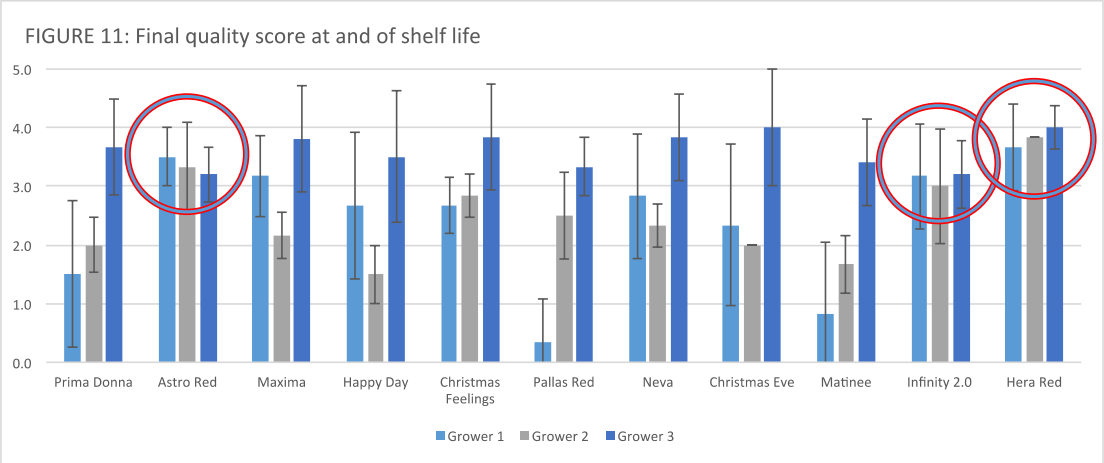

Figure 2. Quality scores for each variety from each nursery at the end of shelf life

The assessors judged Astro Red, Hera Red and Infinity 2.0 as the most consistent highest performing varieties at the end of shelf life. No 57 was also judged to have performed well, but was only trialled on one nursery site. . At the end of the shelf life trial Christmas Eve and Christmas Feeling were also judged to have performed acceptably well.

Of note some varieties showed a high degree of resilience on different nursery sites, in that at marketing stage Astro Red, Christmas Eve, Happy Day, Hera Red and and Infinity 2.0, all had similar (high) quality scores irrespective of production site, and a number (Astro Red, Hera Red and Infinity 2.0 continued this resilience into their shelf life performance. Other varieties were more variable in their responses, for example, Maxima performed better at site 1 than 2. By the end of shelf life, the varietal and grower impacts were more noticeable. The more immature plants from site 3 had better overall shelf life performance, but it is not possible to separate site and maturity factors to establish which are the key drivers for higher performance.

The trials with the aqua pads and wicks were also successful. In these tests the impacts of the aqua pads and wicks were evaluated through a simulated store phase. The trial showed that there were significant differences between varieties and their performance depended on nursery site and growing strategy but in all cases the aqua pads and wicks extended shelf life by five to eight days over a standard control.

During the trial changes in substrate nitrogen and phosphorus levels on one of the trial sites were regularly monitored. This showed that both nutrient levels decline very rapidly during plant growth, and in particular as the crop starts to initiate flowers. The rate of decline was significant and standard nutritional analysis would suggest that the crop might have become deficient in both nutrients. There is a clear need for additional work focussing on poinsettia nutrition and to see if higher applications of either nitrogen or phosphorus from flower initiation have a positive impact on plant quality and shelf life.

These trials via the associated grower open days have assisted the industry in its selection of new poinsettia varieties. We now need to establish if the variety responses are resilient between growing seasons as well as between growers. We are aware that a large amount of new plant material has yet to be evaluated and more diverse and novel material should be included in future trials.

Action points for growers

This trial has highlighted several new varieties of significant commercial interest; these include Hera Red, No 57 and Astro Red; all benchmarked well and were at least equivalent to Infinity 2.0 the current main commercial variety. No 57 were a new potential introduction from Beekenkamp and although only examined on one site it is clearly worthy of further investigation. The new variety Astro Red and Hera Red also performed very well when assessed both at marketing stage and at the end of shelf life. These varieties were also resilient to all sites in the trial, suggesting they may have potential for wide use across the UK grower base. It should also be noted that the main UK commercial variety Infinity 2.0 also performed well and is still amongst the top ranking varieties assessed in this trial.

SCIENCE SECTION

Introduction

The UK poinsettia industry has had a high reliance on relatively few poinsettia varieties. The variety with the largest penetration is Infinity (c. 80% of the UK volume), followed by others such as Titan, Christmas Feeling, Prima, and Christmas Eve. The UK market tends to require slightly taller plants than the typical EU product, with clean red bract colours contrasting against dark green leaves. Prominent cyathia are frequently required, but without pollen.

There is now considerable interest in the use and exploitation of new varieties for the UK market. There are concerns that key varieties, which have been in the market for a number of years, are now starting to show non-typical or variable traits and habits. This may be due to issues with stock plant maintenance over a number of years.

A recent HDC Poinsettia growers study tour to the Netherlands (2014) showed that plant breeders are actively working to breed new varieties or to develop improved stock management processes to "reboot and revamp" existing varieties. However, the number of new varieties entering the market is significant. These varieties are bred internationally, in particular in Europe, but not in the UK. The stock can be maintained in diverse areas such as Europe, Africa and Central America.

The process of variety selection by a grower is not simple. Growers will acquire insight from a number of sources, including own tests, visits to other growers, breeders and research stations, discussions with buyers, personal views regarding customer needs, extension services and documentary sources. Growers will also need to consider how a variety "fits" with their own facilities and production techniques. The process of variety selection is very expensive and time consuming, poor decision-making can also have significant negative commercial consequences.

Improved and more effective decision making on variety selection can be established by understanding if there are significant grower x genetic interactions, i.e. do all varieties perform relatively the same on different holdings. If they do perform relatively the same on different holdings, then it will suggest that varieties are relatively robust between growers. If there are significant interactions, i.e. varieties do not perform relatively the same between holdings, and then variety decision-making will be complex. If no interactions exist then variety selection might be made following the

testing, on nursery, of relatively few varieties benchmarked to standard commercial controls. If interactions do exist then to make an effective decision it will require own on nursery tests of a very wide range of varieties, since it will never be clear how they perform until they are grown on a specific site.

Variety selection should also include an assessment of consumer performance. Shelf life trials are though difficult and costly to undertake at a grower level. Furthermore, a number of approaches to increase the resilience of the product postproduction are coming onto the market; these include the use of anti transpirant chemicals, small water absorbing plugs and the addition of “wick” water uptake mechanisms. These products have not been tested under controlled conditions to determine their efficacy.

Given this background, the objectives of this trial were to establish a more rigorous process to underpin the effective selection of Poinsettia varieties, in particular, we;

- Rigorously tested 12 old and new varieties for use by UK growers
- Tested the varieties on 3 different UK grower’s holdings to establish whether any genetic x grower interactions occurred in terms of plant responses.
- Established the impact of post harvest water management strategies (wicks, anti transpirant, water absorbent plugs) on product post harvest life.

Benefits to the industry

Poinsettias are one of the most important pot plant crops between July and early December. Up to 8m Poinsettia are sold within the UK market, with c. 3.5 to 4m grown in the UK, and a market value of c. £10m to £12m p.a. at farm gate values (in pot sizes 10 to 17cm). Given that 50% of the UK crop is imported, typically from Holland, these figures suggest a significant potential for import substitution. Contrarily given the current euro exchange rate (c. 1.30 euro per £), it is likely that competition from EU exports will intensify. Given the risks and opportunities for this sector, it is critically important that the industry have clear insight to develop compelling competitive advantages for UK produced crop. Reduced heating costs as a consequence of the introduction of biomass heating systems has also made the crop a more attractive proposition for some growers.

The benefits of the experiments conducted here are multi-faceted. It provides UK growers with effective insight into the commercial performance of a wide range of new Poinsettia varieties benchmarked against current commercial controls. Variety choice

is one of the most important decisions made in Poinsettia production; it is a critical factor in determining the commercial success of the crop. The experiments were designed to demonstrate whether varieties are robust and stable under a range of different commercial conditions. If variety performance is stable between growing sites, then this may simplify variety selection going forward as it provides a higher level of confidence that the selection is robust. If varieties perform very differently between sites, then large numbers of selections will need to be made each year to find the best variety for a particular site and circumstance. The work on post harvest water management also establishes whether simple processes can be implemented to improve product postharvest life. Higher levels of postharvest life will help underpin a higher level of consumer confidence in the product and increased repeat sales.

Materials and methods

Three experienced Poinsettia growers located across England kindly agreed to participate in the trials;

Pinetops Nurseries, 59 Ramley Rd, Lymington, Hants (see attached image).

The crops at Pinetops were produced on mobile benches within state of the art glasshouses, with a final spacing of 8 plants per m^2.

Delamore Ltd, Station Rd, Wisbech St.Mary, Camb, PE13 4RY

The plants at Delamores were grown in modern glass on the floor using ebb and flow watering systems and spaced at 8.5 plants per m^2.

KRN Houseplants, Fotherby, Lincs, LN11 OTG

The crop at KRN was grown in a medium sized glasshouse on static benches using a capillary mat irrigation system. Final spacing was 8 plants m^2.

These growers were selected as they cover a broad range of geographical locations and facilities. The aim was to find growers producing on tables and on the floor, with varying ages of glass.

Varieties for the trial were provided by the key breeders focussing on the Northern European market; Dummen, Beekenkamp, Syngenta and Selecta. The variety selection process was to contact the key breeders (with marketing capacity within the UK market) to develop a preliminary list of potential varieties. The final selections were then led by UK growers and by circulation of key members within with the BPOA. The varieties tested were;

- **Beekenkamp:** Astro Red (7.5wk), Hera Red (8.5wk), Pallas Red (7.5wk), No 57 (one grower only and plants received 2 weeks later than the initial batch)
- **Dummen:** Infinity 2.0 (8wk), Prima Donna (8wk), Maxima (8wk), Matinee Bright Red (8wk)
- **Selecta:** Christmas Feeling (8.5wk), Christmas Eve (7.5wk), Happy Day (8.5wk)
- **Syngenta:** Neva (8wk)

Plants were dispatched directly to the growers in week 30 and immediately potted. Each grower received 128 plants of each of 11 varieties (plus a 12th at one grower). At each grower the plants were planted into standard Bulrush poinsettia substrate. Plants were grown under commercial conditions and maintained in one large block per grower. This ensured adequate guarding of the central experimental plants and also each variety to be treated as a single commercial entity. The crop was grown under the standard conditions at each site, this including site-specific nutrition, environmental, irrigation and PGR variables. Regular nursery visits were undertaken by Mr Kitchener to oversee the trials, and to provide support. Detailed crop records were taken, these included records of PGR applications. In terms of PGR applications, the following sprays were applied;

1. Pinetops: Fargro CCC (450g/l chlormequat chloride): up to 8 x 0.25ml / l + 2 x0.5ml/l + 2 x 1ml/l
2. Delamores: 3C Chlormequat 750 (750g/ l, chlormequat chloride 65.2 w/w): 13 x 1ml/l
3. KRN: 3C Chlormequat 750 (750g/ l, 65.2 w/w): 3 x 1ml/1 + 2 x 1.5ml/l

At marketing stage (19th to 21st November) in each site, measurements of plant performance were taken on 6 replicate plants per variety, data included visual quality scores (all by the same scorers), plant height, bract number, and plant width and break number. Compost analysis was also undertaken to understand variances in nutritional

uptake and provision between varieties and growers. Samples of all varieties from all growers were assembled at Delamores on the 22nd November for the AHDB Poinsettia open day. Growers were offered the opportunity to assess and score all batches grown.

After the open day on 22nd Nov, 6 replicate plants from each grower and variety were sent to The University of Lincoln for shelf life testing (see Plate 1). Plants were transported in standard in transit boxes and left in these boxes for 3 days. Thereafter the plants were laid out on benches in a completely randomised design. They were maintained in grower sleeves for the first 5 days of shelf life to replicate store conditions. The plants were placed on pot saucers and each plant was given an identical amount of tap water at each watering. The average daily water consumption per plant was 30ml per day. The shelf life room at Lincoln was equipped with warm white LED panel lighting to provide 1000 lux for 12 hours per day. Temperature was maintained at 18 to 22ºC (average recorded 19.5ºC) through the day and night, with relative humidity recorded between 27 to 65% (average 47.8% r.h.). Plants were monitored weekly until a final assessment on the 6th Jan. Data recorded were visual quality assessments undertaken by the same scorers on each occasion for consistency. Full photographic records were taken. All statistical data was analysed independently by Mr John Flynn, statistical advisor to the University of Lincoln.

Plate 1. The shelf life room at the University of Lincoln.

In addition using plants of Infinity 2.0 from one grower, experiments were conducted to assess the impact of wicks (right picture), and two types of aqua pads provided by Pokon and Chrysal (standard, circular, centre image and wrapped, square, left image) on shelf life judged against a control.



10 randomly selected plants were used for each treatment. The control plants and aqua pad treated plants had their pots wrapped in a sheet of clear cellophane. This simulated a typical cover pot (or ceramic outer pot) that is required for the aqua pads. Aqua pads were inserted between the cellophane and the pot base and 110ml of water was injected into the cellophane wrapper. For the wick treatment, the Waterwick™ system of Pöepplemann Teku was used (see https://www.poeppelmann.com/uploads/tx_ppinfomaterial/Coverpot_MDF_Folder_GB_01.pdf). With a plastic insert, the wick was pushed into the compost through a hole in the base of the pot. This connected the wick to the compost. A part of the wick trailed from the base of the base of the pot and this was inserted into a pool of 110ml of water in an outer pot, the same amount as applied for the aqua pad treatments. These plants were subjected to shelf life analysis (40 plants in total). End of shelf life was noted when the plants visibly started to break down and wilt.

Results

Figures 1, 2, 3 and 4 show a comparison for all varieties of the quality of the plants at the start of post harvest matched to the same variety at the end of shelf life. The start of shelf life plants are from the same grower and the end of life samples are representative of the total population.

Figure 1. Marketing Stage, 1st November

Figure 2. Marke ng stage,19thNov

Happy Day ChristmasFeelings PallasRed

Shelf life, 31st Dec

Figure 3.Market stage,19thNov

Neva Christmas Eve Mathee

Shelf life, 31st Dec

Figure 4, market stage 19th November

The key differences between each of the varieties are further described below, and illustrated within the quantitative data. Figure 5 illustrates the impact of site on crop maturity at harvest; this shows that for Hera Red site 1 plants were 10 to 14 days ahead of sites 2 and 3. On the 21st November site 3's crop would have been considered to be immature for marketing at that point. Similar trends were seen across all varieties.

Figure 5:Hera Red from all three site photographed on 19 to 21st of November

Site 1 Site 2 Site 3

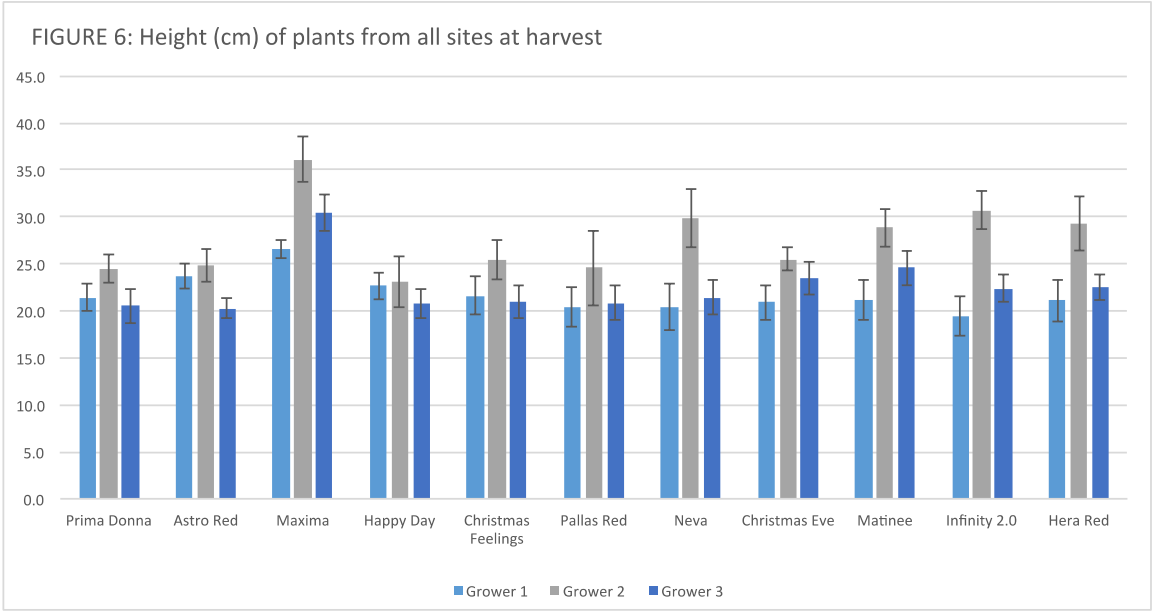

Figure 6. shows the plant heights recorded for each variety and site at marketing stage.

This showed that there were no significant differences in height between site 1 and 3, but plants were taller for site 2 ($P<0.01$). The tallest plants were for Maxima, but for site 1 and 3 there were no significant differences in height between the other varieties.

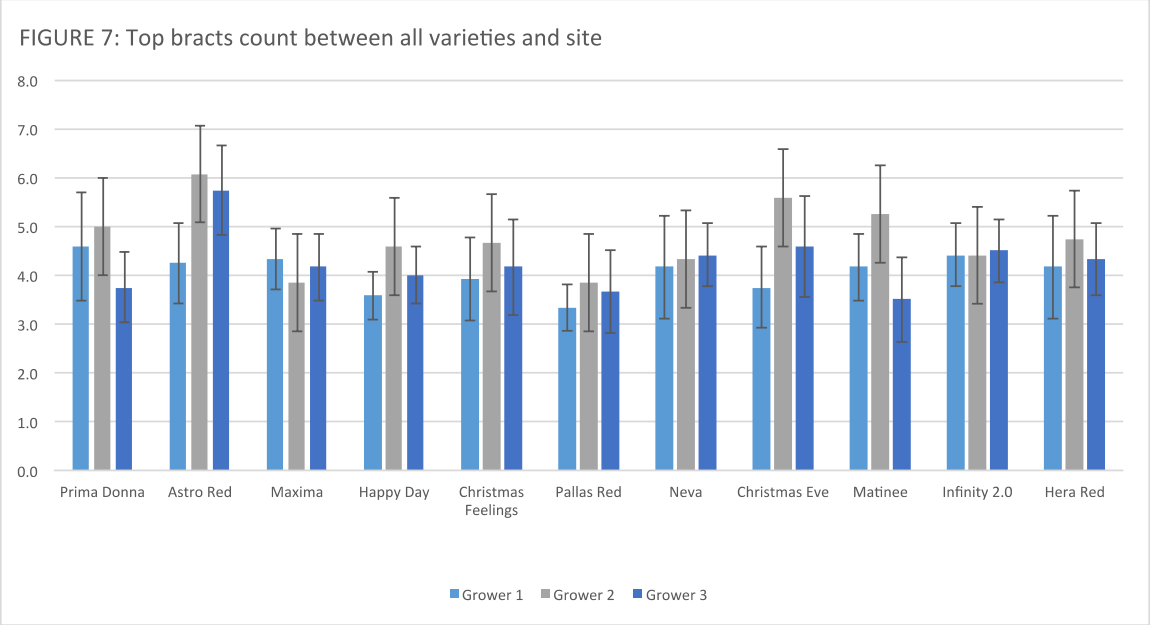

Figure 7. shows the variance in bract count between all the varieties and sites at marketing stage. These tended show a relatively high amount of plant-to-plant variability. The largest bract number was found on Astro Red (c.5+ per plant), whilst most varieties had c. 4 bracts. Site 3 tended to show slightly more bracts on some varieties although the differences were not significant.

Figure 8. shows the quality score (out of 5) for each of the varieties at the marketing stage. The lowest scores were found for Pallas Red (2.5 to 3.5). These plants tended to have low stature and total biomass. There were also some varieties that were inconsistent between sites, for example Maxima scored well at site 1, but not at site 2. Highest scores were recorded for Astro Red (compact plant with high bract number),

Happy Day, Infinity, Christmas Eve and Hera Red. The important feature of all these varieties was that the quality score was consistent between sites. This suggests these varieties and resilient and perform robustly at all sites.

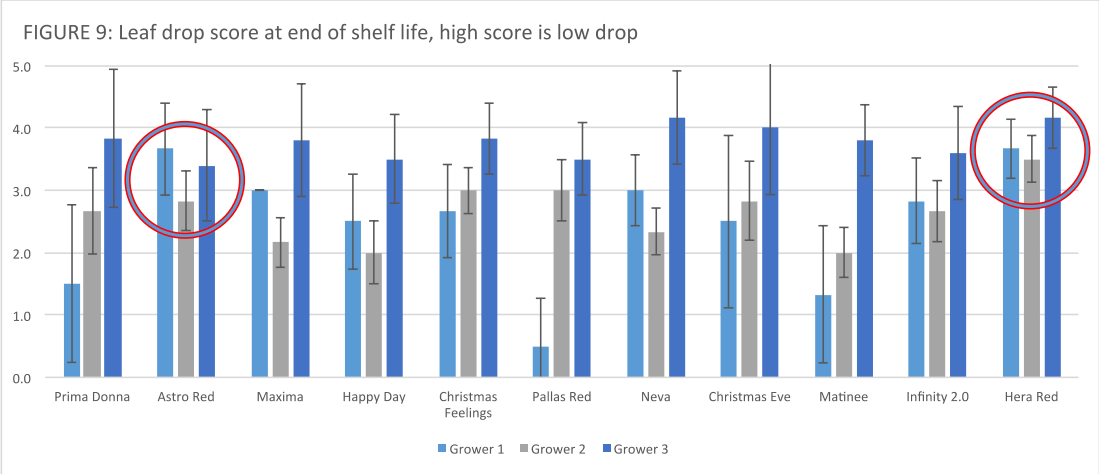

Figure 9. shows data recorded on the 6th January for leaf drop towards the end of shelf life. This data showed very considerable differences between varieties and sites. The poorest performing variety was Pallas Red, where the majority of plants from site 1 were dead by the end of shelf life. Matinee also performed inconsistently plants from site 1 and 2 dropped leaves earlier than those from site 3. The most resilient and best performing varieties in terms of leaf drop by the end of shelf life were Astro Red, Infinity 2.0 and Hera Red. There was also a significant effect of site ($P<0.01$); site 3 had significantly less leaf drop than the other two sites. The interactions were also significant, for example Hera Red performed well independent of site.

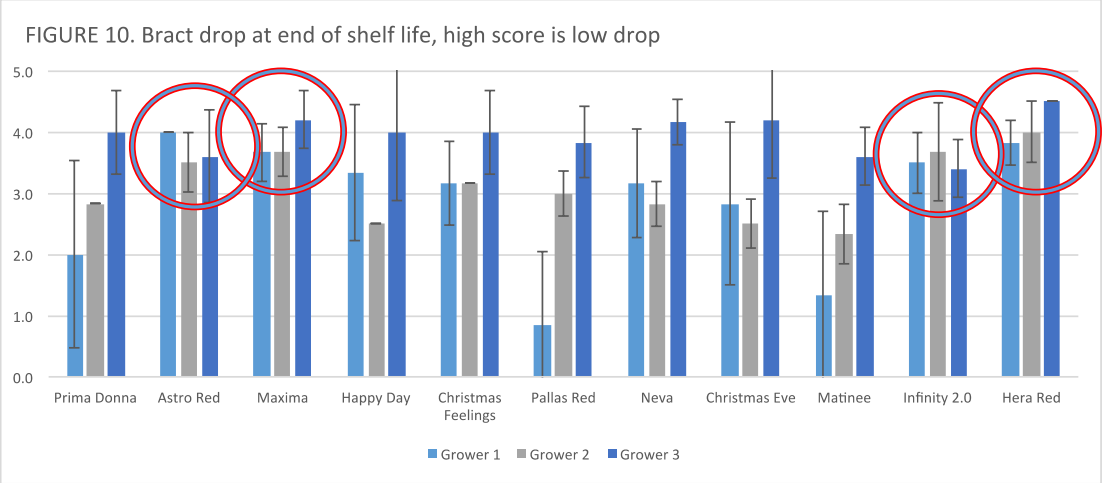

Figure 10. Similar data were recorded for final bract drop. However, in this instance Maxima retained a relatively high proportion of its bracts compared to leaves. Again Astro Red, Infinity 2.0 and Hera Red performed well in terms of bract retention.

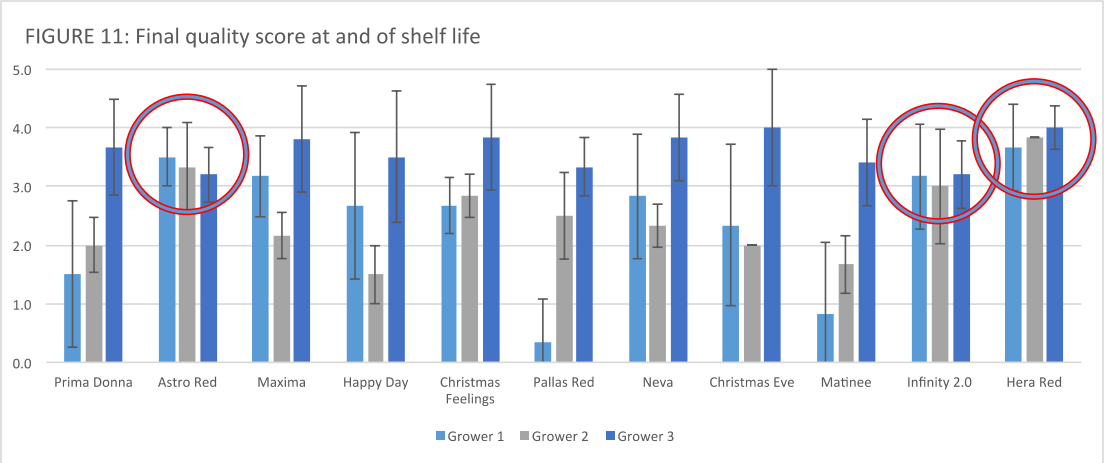

Figure 11. shows the final quality scores at the end of shelf life. This shows that Prima Donna, Pallas Red and Matinee performed relatively poorly at least with sites 1 and 2. Of note all varieties tended to perform well with site 3. However, it should be noted that the plants form site 3 were backward relative to growers 1 and 2 at the start of shelf life testing. The best performing and most resilient varieties were Astro Red, Infinity 2.0 and Hera Red. These varieties performed consistently at all growers and therefore conditions during this trial. No 57, which was only grown by site number 1 performed well and scored 4.0.

At the end of the open day all the grower delegates to the AHDB open day were asked to score each of the treatments to provide a more grower focussed assessment of overall quality (24 data sets were received, see Fig 12).

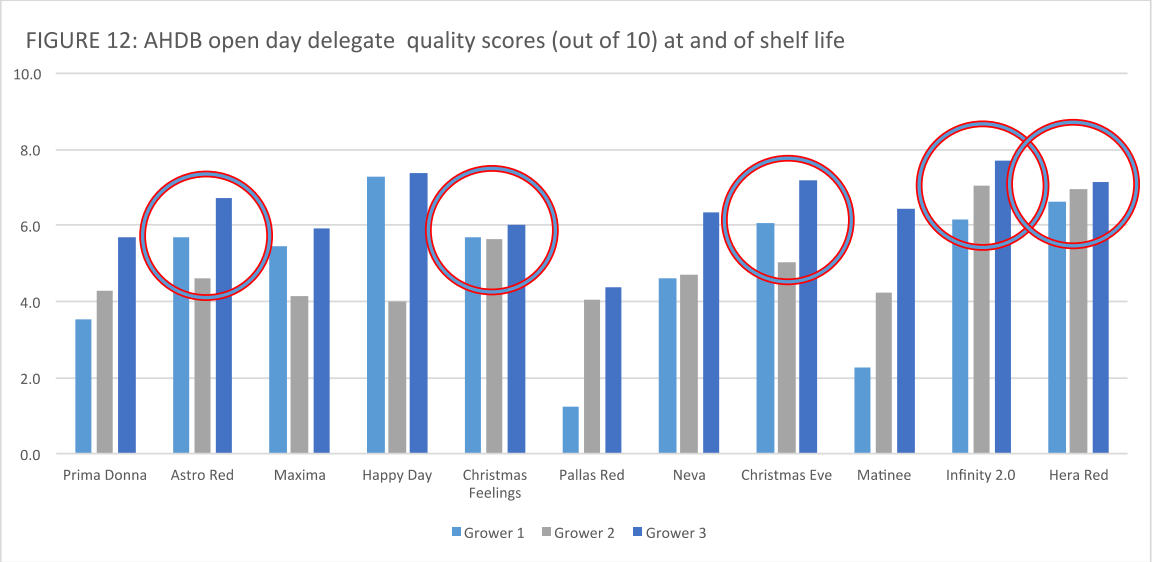

Figure 12. These scores were broadly similar to those of the trial assessors, again the open day delegates rated Hera Red, Infinity 2.0 and Astro Red highly. However, they

have slightly higher quality scores for Christmas Feeling and Christmas Eve. Happy Day for growers 1 and 3 also scored highly and grower 3 tended to produce the highest quality of all the growers at the end of shelf life. The new variety No 57 performed well in the grower scores at 6.6. This was only grown at site 1's site, and was the second highest score of all of site 1's varieties. No 57 is worthy of further investigation in future years and have potential.

Substrate Analysis

The poinsettia monitoring scheme has been running since the late 1990's. Over the years there have been a varying number of growers using the scheme and obviously the varieties being monitored have changed. The move from Cortez and Sonora to Infinity being the dominant UK variety of choice has probably been the biggest change. Even with the changes in varieties over the years, there have been trends in some of the results which have continued.

The most marked trend has been the level of water soluble 'P' recorded during the growing season and this is illustrated by the results from the monitoring for the 2015 season. These results are from one set of data for one of the participating growers in the 2015 trial. From the data over the years it is suggested that a substrate level of below 20mg/l P is likely to cause lower leaf interveinal yellowing and eventual loss of those affected leaves. Historic data suggests that even varieties such as as Infinity may to be susceptible to this condition. In 2015, the real drop off in the 'P' level occurred towards the end of August and into early September. At this point and although there are no visible signs the plant will have started to initiate the processes leading to flower initiation. The plants at this point require very high level of 'P' at the apical growth points and will rapidly deplete available 'P' from the substrate, Figure 13, and will then mobilise P from the older leave tissue to make up any shortfalls, this leads to the symptoms we observe.

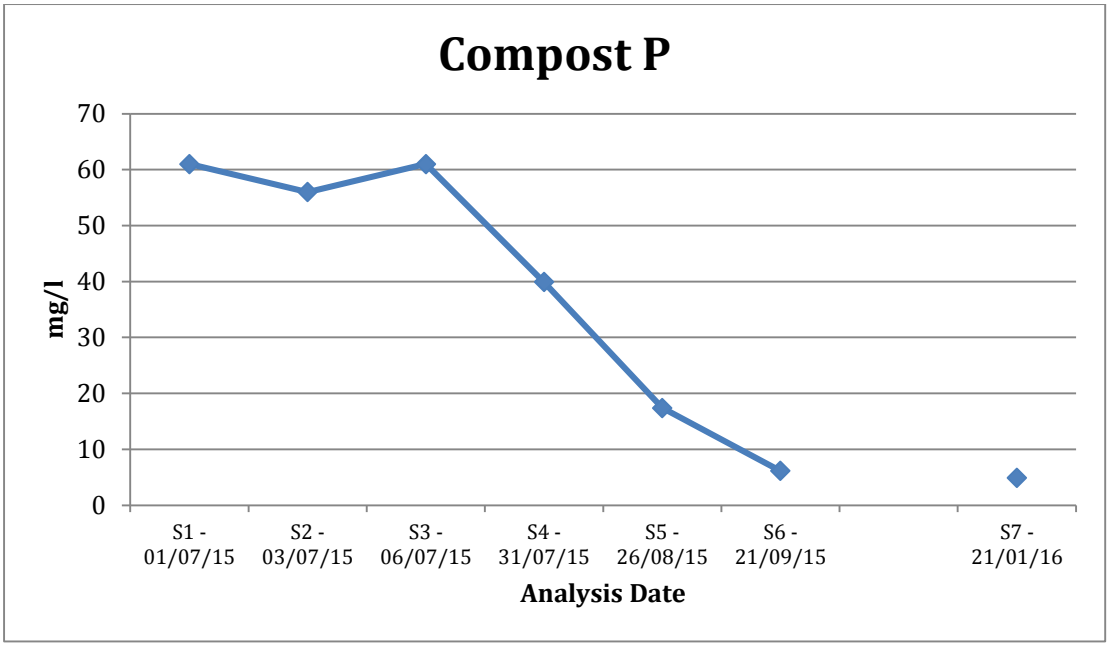

Figure 13. Change in substarte P recorded at one grower during the 2015 poinsettia trials.

Note the outlier point on the graph, Sample 7, was the result of the samples taken at the end of the shelf life study.

Plate 2. Typical P deficiency symptoms for a Poinsettia, NCSU.

For illustration the above plate 2 shows the typical Poinsettia phosphate nutritional disorder symptoms *from Brian Whipker, Ingram McCall and Jared Barnes, North Carolina.* During the monitoring the limited tissue data collected showed a sharp decline in the levels of 'P' in the tissue (Fig 14). As a guide it would be normal to maintain the leaf tissue levels to a minimum of 0.6% to avoid leaf symptoms appearing.

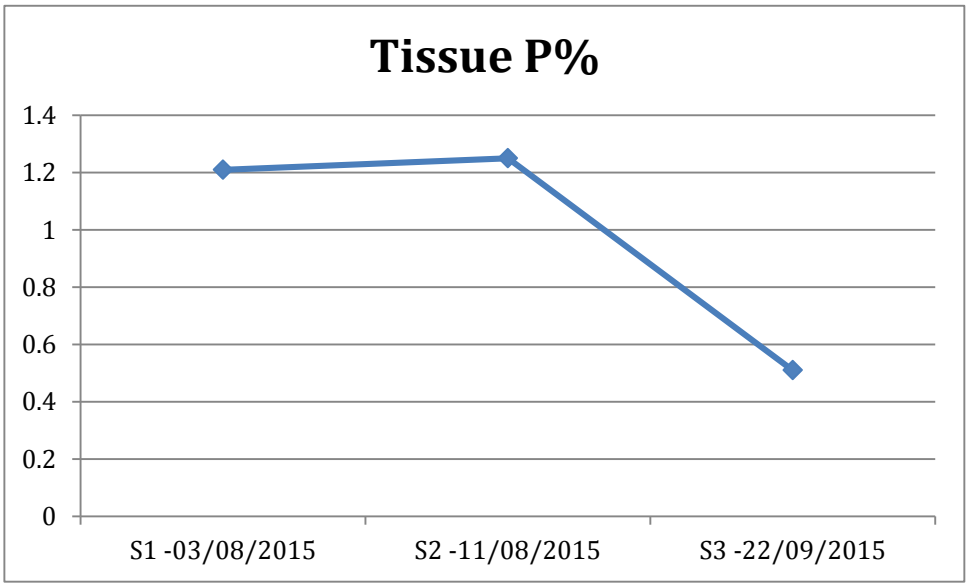

Figure 14. Change in tissue P as the season progressed.

Fig 15 shows the water soluble levels of Total N in the substrates examined. Again there was a steep decline in the Total N (TON) level into September, but there were no visual indicators that the plants suffered. Interestingly the outlier S7 is the result at the end of shelf life and initially appears at odds with the previous results. On investigation it was found that prior to entering shelf life the pot substrates were all thoroughly wetted from above and this would have released and redistributed the accumulated 'N' in the surface layers of the mix, hence the slight spike on the graph. Whether this is advantageous towards the shelf life remains a question.

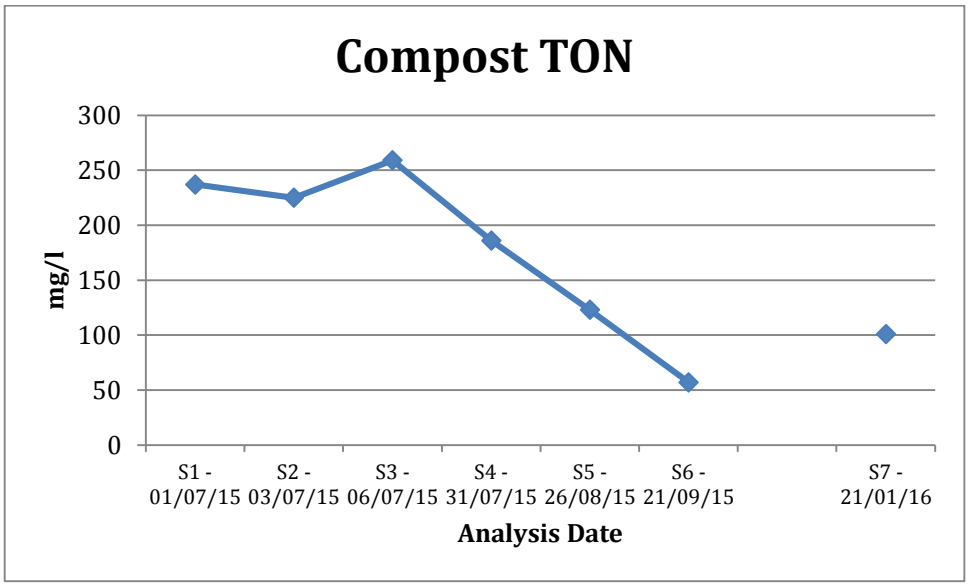

Figure 15. Change in total substrate N through the growing season

The results of the monitoring this last season confirmed the trends observed over the years of the monitoring scheme that specifically the plants towards the end of August and into September require large levels of available 'P'. If this is not available then the plants will withdraw the 'P' from the older leaves and then visual symptoms appear, but by such time this cannot be reversed in the affected leaves. Therefore the monitoring of substrate 'P ' levels and the switch to high 'P' feeds for a period of at least 2 to 3 weeks from the end of August into mid –September is essential. A suggested feed is a 10-52-10 at 1kg/per 10 litres stock applied at 1 in 100 (1%) at every watering during the period and analysis of the substrate and leaf to confirm levels of nutrients.

Postharvest Water Treatments

Plate 3, 4, 5 and 6 show the post harvest treatments photographed on the 23 December. This was a stand alone experiment using only plants of Infintity 2.0. The control (unwatered) treatment started to break down on the 14th December and were unmarketable by the 17st December (27 days into shelf life). They were followed by the Aqua Pad 2 treatment (square enclosed piece) which lasted 5 days longer and the Wick and Aqua Pad 1 treatment both lasted 8 days further than the control. All treatments therefore extended the life of the product over the control. It is also likely that these systems may further improve the resilience of the product once it arrives at the consumers' home. This is because the wicks and pads will provide a larger water buffer for the plant. This though needs confirmation with further studies.

Plate 3. The unwatered control plants on the 23rd December

Plate 4. The Aqua Pad 2 plants on the 23rd December

Plate 5. The Wick treatment on the 23rd December

Plate 6. The Aqua Pad 1 treatment on the 23rd December

Discussion

The aims of these trials were to establish the most robust varieties that can be used by a range of growers, and are consistent in performance between all growers. This trial suggests that the highest performing and most resilient varieties were Hera Red, Infinity, Astro Red, Christmas Eve and Christmas Feeling. These all originate from a broad range of breeders, suggesting on this limited test, no clear point of difference between breeders on variety performance. Some of the varieties are relatively new to the market (for example Astro Red and No 57) and performed relatively well. There is clearly a need to test a wider range of material and start to understand why certain varieties are more robust than others. The reason for variety robustness across sites is not clear; it may be a function of the quality of the mother stock, unknown genetic factors, tolerances of both biotic and abiotic factors. Astro Red was also unusual in that it had a relatively high bract count, though each bract tended to be smaller compared to other varieties.

The reasons for the large grower differences are largely unknown but worthy of further investigation as it may underpin the development of more robust productions systems. At harvest the plants for grower 2 tended to be taller than those for growers 1 and 3. This may reflect differences in PGR applications, since grower 2 used 5 applications of cycocel compared to up 13 for growers 3. Further work is clearly required to understand the basis for differences in height achieved and the impacts of different plant growth regulator regimes. Although this work has been conducted in the past, the significant genetic differences in response seen here suggest that further research is required to underpin height control approaches with modern varieties.

One of the key differences between growers was the maturity at harvest (19th to 21st Nov). Plants from grower 1 were two weeks more advanced than the other 2 growers. The least mature plants were found with grower 3. This may partially reflect why the plants from grower 3 performed so well during shelf life, they were simply at a less advanced developmental stage. It is not clear why the plants from grower 1 were so mature, however, these were grown in modern glass on the South coast and so it is reasonable to assume that light level may have been a factor. Given these maturity difference there may be opportunities to explore ways to improve the scheduling of Poinsettia between growers; growers on the south coast may need to plant later than those in the North or use different response groups. Growers in the north alternatively may need to plant earlier. These differences will be compounded with local differences

in facilities (age of glass and light transmission) and glasshouse temperatures.

The nutritional analysis showed very clear changes in compost nutritional content through the trial, and the decline in P and N concentration was quite dramatic. It is not clear if these reductions negatively impacted shelf life, but the extent of the changes suggest further work is required on the nutrition of Poinsettia. These results raise concerns that current feeding regimesmight not be providing optimal N & P levels required to sustain the plant through shelf life.

The informal observations with the wicks and aqua pads performed well. There was at least a five to eight day extension in shelf life for all the wick and aqua pad treatments. This suggests they effectively transferred the additional water into the substrate. The commercial benefits of these tests are for consideration by the growers themselves, in discussion with the aqua pad and wick suppliers.

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