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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

Project Background and Expected Deliverables

Growers within the UK rely upon relatively few poinsettia varieties, with Infinity 2.0 accounting for up to 65% of the current volume. The crop is grown to harvest from mid-November until Christmas as decoration for the domestic market and stringent specifications must be met. The UK market leaders tend to specify a plant 25-30cm high, slightly taller than the EU product, planted into 1 litre pots with a foil of dark green leaves to clean red bracts. The cyathia should be prominent without pollen.

Two trials are reported here:

1) Variety assessment
2) Water deficit work for plant growth control

1) The main objective of this variety trial was to build upon previous work, the plants were benchmarked against the current main commercial variety, Infinity 2.0.

   AHDB research in 2015/16 assessed the several new poinsettia varieties which were coming onto the market through growth and shelf life trials, amid industry concerns of reliance upon existing varieties and stock plant maintenance. The results of that trial showed varieties such as Lenora (was No.57), Ferarra, SK148 (now Christmas Sensation) to be promising, and Astro Red, which has continued to show interesting results in 2017/18.

   The poinsettia varieties were trialled on three different grower holdings (Pinetops Lymington, Volmary Wisbech St Mary and KRN House plants Louth) across the UK. The crop grown in the northern location was noted at harvest (10 days after the southernmost location assessment date) as still to benefit from an extra week of growing time. The cause of the delay in harvest maturity was unknown, but location and therefore the environmental factors of light and temperature could potentially have had an effect. There were also differences in structure, temperature control and approach to watering and nutrition. (These are reported later in the materials and methods section).

2) A second aspect, the water deficit trial, was based upon industry concern regarding the reduction to two applications of important plant growth regulators (PGRs) such as chlormequat, as early as 2017/18. PGRs have been critical to growers in enabling them to control crop size so attaining product specification. The removal of PGRs may hinder UK growers' ability to meet market specification and so increase vulnerability to competition.

The water deficit trial was carried out by Neame Lea, Spalding. (Details in the materials and methods section). The following was investigated;

a. The reassessment of the potential of using soil moisture sensing, combined with soil moisture deficit to control stem extension and plant height. This was a continuation of research carried out by Mark Else (NIAB EMR) in a DEFRA funded project (HH3609STX) at Staplehurst Nurseries, Kent (2004-2008). This involved the remote monitoring of three substrate mixes while using Regulated Deficit Irrigation (RDI) during the period of rapid stem elongation in a commercial set up, to see if it controlled plant stem height, and so reducing the reliance on PGRs. The formation of a transferable model of precision irrigation to maintain "optimum" moisture content, capable of being scaled-up to full production and transferable to other crops. Advances in probe technology have increased crop test coverage and robustness of results.
b. To identify the substrate moisture content at which visible wilting first occurs under a range of Vapour Pressure Deficits (VPDs).
c. Engagement with the separate, but complementary current Bedding and Pot Plant Centre project led by ADAS on the evaluation of new active ingredients for poinsettia growth and quality.

Benefits to Industry

Poinsettias are the main stay of ornamental pot crops for glasshouse production between July and early December. Approximately 8 million poinsettias were sold within the UK market in 2016, making it one of the most popular seasonal houseplants, predominantly in red bracts on green leaves. UK growers produce approximately half of the retail consumption with the remaining supply produced predominantly in Holland. With changing import markets and euro exchange rates due to Brexit, there are risks to, and opportunities for, the UK industry to develop and expand in this market while maintaining competitiveness. The reduction in distribution distance and time from UK growers should help to improve plant quality in the home market and gain a competitive advantage.

Benefits of the variety trial

This project followed upon the results of the previous trial, reaffirming year-on-year resilience for several of the newer varieties. The trial provided UK growers with knowledge regarding the performance of new and previously tested new varieties against a known benchmark crop (Infinity 2.0). The crops were grown in a variety of commercial operations, conditions and locations, all representative of the industry, so allowing growers to judge consistent varietal resilience, performance and reliability. The trial also showed that some varieties performed less well and may not be suitable for the UK market, as well as demonstrating how different

varieties perform at harvest and then through shelf life. High quality scores at harvest did not always follow through into shelf life, an essential aspect for consumer satisfaction.

Benefits of the water deficit trial

A “dry growing” regime where the irrigation was restricted and monitored using in-pot moisture sensors combined with data logging and remote monitoring (telemetry), was effectively used to achieve plant height control without the use of PGRs. This approach has the potential to significantly reduce the use of PGRs on this and other protected crops in which control of plant height or growth is needed.

Summary of the Variety Trial

Varieties from a number of plant breeders were tested;

Plant breeder	Variety
Beekenkamp	Astro Red Lenora Red Pon 94 (no longer available)
Dummen	Infinity 2.0 Ferrara, Prima 2.0
Selecta	Christmas Feeling Christmas Cracker SK148 (Christmas Sensation)
Syngenta	Titan Magma

Upon receipt of the plants (17th November) at the University of Lincoln, there were substantial differences in crop height and width between growers. Figure 1. The plants from the water deficit trial were grown with no applications of PGR’s at Neame Lea and the plants from the northern-most nursery could have benefited from a further week of growth before retail.

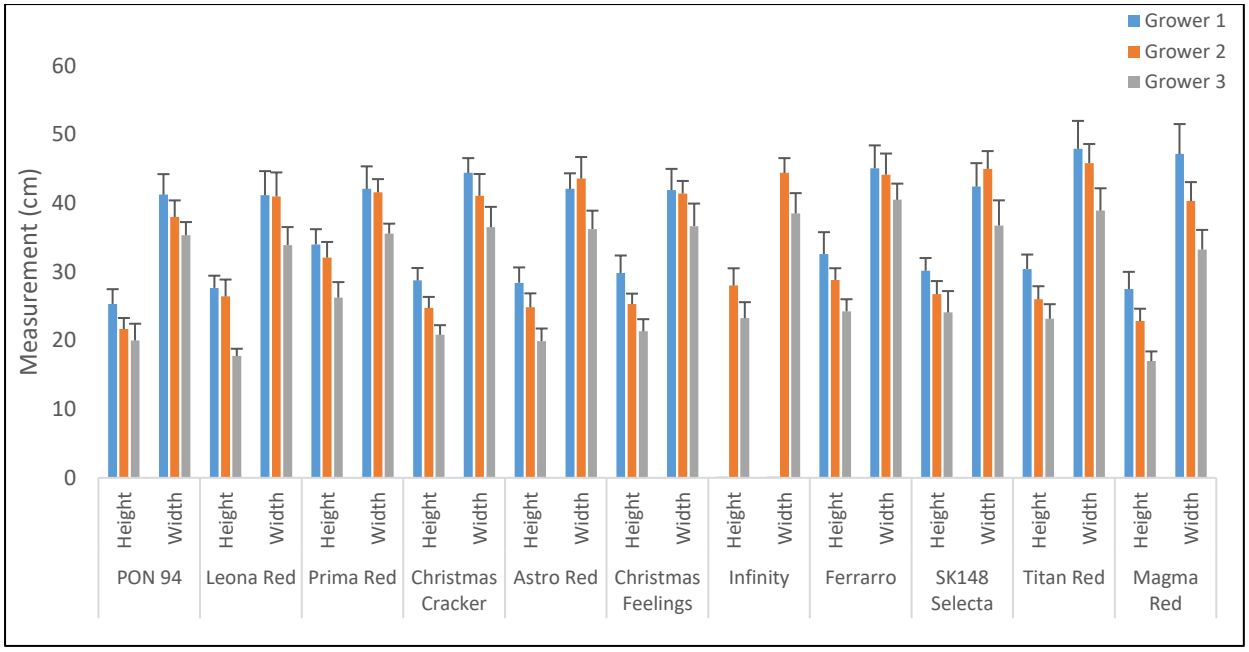

Figure 1. Mean plant height and width at harvest on grower's sites, per variety, showing standard deviation, n=12

At harvest, the varieties showed similar quality scores irrespective of nursery site indicating product resilience across different locations and use of growing techniques; in particular Christmas Cracker and Christmas Feelings. However this scoring consistency across the growing locations did not necessarily relate to high quality scores. The most variable variety across the different grower sites was Lenora Red.

There were key differences between grower sites in the facilities deployed and growing approaches. The facilities ranged from state-of-the-art modern glass to more traditional structures.

Table 1. Combined quality score at harvest and various stages of shelf life indicating varietal resilience across shelf life.

Variety	Open day grower score	Harvest Nursery Score	Shelf Life 21st Dec	Shelf Life 12th Jan
Pon 94	5.7	6.2	4.1	2.8
Lenora	5.9	5.3	4.4	3.2
Prima	5.7	6.8	4.2	2.9
C. Cracker	6.0	6.8	4.2	2.9
Astro	6.2	7.4	4.6	2.8
C. Feeling	5.1	6.2	4.5	2.9
Infinity 2.0	5.9	6.5	4.5	3.1
Ferrara	5.8	6.8	5.1	3.4
SK148 (Christmas Sensation)	6.0	7.7	4.7	3.5
Titan	6.1	6.4	4.5	2.9
Magma	4.6	4.0	4.0	2.3

The results in Table 1 show Magma had the lowest quality score at all points of assessment, whereas SK148 (Christmas Sensation) performed well in harvest scoring and throughout the shelf life assessment.

At the end of shelf life assessment, the differences in varietal and grower impacts were more noticeable, although most plants survived until this stage with a loss of only five plants out of 210 by the second open day (16th January). The Infinity 2.0 bract colour was true to type prior to shelf life assessment, but it appeared to soften during shelf life; the cause is not known. Figure 2.

Figure 2. Infinity plants, grower 2, shelf life 17th November (left) and 12th January (right) showing colour softening.
Source; Le Grys 2017 & 2018

Summary of the Water Deficit Trial

Water deficit was used in conjunction with graphical tracking to manage stem height, and in doing so plant height control was achieved effectively without use of PGRs. A Substrate Volumetric Moisture Content (SVMC) below 20% by volume was needed to slow stem elongation and this was achieved twice during the “dry growing” regime practised at Neame Lea. Previous DEFRA-funded work EMR (now NIAB EMR) showed that repeated exposure to water deficits over a 3-week period optimised growth control.

The moisture sensors, data loggers and telemetry were reliable, while remote access to real-time data was informative for the grower’s decision-making process on the frequency and duration of irrigation. Data indicated the rate of change in substrate moisture content correlated with daily VPDs as expected.

Three substrate mixes were used in the water deficit trial. The mixes differed in their composition and hence their moisture retention and rewetting characteristics. There were no nutritional limiting factors during crop production. There was an observable difference in the root type and structure between the mixes. The plants all responded to the moisture deficit application and all had very good shelf life.

The open day discussions raised issues relating to relevance and feasibility of “dry growing” for non-ebb and flow bench operations and the need for mobile sensors to allow for bench movement in a commercial operation. It is anticipated that future trials will address these issues.