Grower Summary

PO 022

Developing precision and deficit irrigation techniques to reduce reliance on PGRs and to optimise plant quality, uniformity and shelf-life potential in commercial protected pot and bedding plant production

Annual Report 2021

Project title:	Developing precision and deficit irrigation techniques to reduce reliance on PGRs and to optimise plant quality, uniformity and shelf-life potential in commercial protected pot and bedding plant production
Project number:	PO 22
Project leader:	Dr Mark Else, NIAB EMR
Report:	Annual Report, January 2021
Previous report:	NA
Key staff:	Mike Davies, NIAB EMR June Taylor, NIAB EMR Hilary Papworth, NIAB
Locations of project:	NIAB EMR, New Road, East Malling, Kent ME19 6PR, UK. NIAB, Lawrence Weaver Road, Cambridge CB3 OLE, UK. Staplehurst Nurseries Ltd, Clapper Lane, Staplehurst, Kent TN12 0JT, UK. Neame Lea Ltd, Horseshoe Lane, Spalding, Lincs. PE11 3JB, UK. Volmary Ltd, Station Rd, Wisbech St. Mary, Cambridgeshire, PE13 4RY, UK.
Industry Representative:	NA
Date project commenced:	1 August 2019

DISCLAIMER

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

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.

Mike Davies

Scientific Support Specialist

NIAB EMR

Signature Date 30 January 2021

June Taylor

Scientific Support Specialist

NIAB EMR

Signature Date 30 January 2021

Report authorised by:

Mark Else

Head of Department, Crop Science and Production Systems

NIAB EMR

Signature Date 30 January 2021

GROWER SUMMARY

Headlines

- Poinsettia plant height and quality specifications at dispatch were fully met when Regulated Deficit Irrigation (RDI) was used as a non-chemical method of growth control on a commercial nursery;
- Shelf-life potential of RDI-treated plants was improved compared to plants sprayed with PGRs;
- RDI should only be applied to plants with well-developed root systems.

Background

In Defra-funded work carried out by NIAB EMR and Staplehurst Nurseries Ltd between 2004 and 2008, we showed that Regulated Deficit Irrigation (RDI) applied during the period of rapid stem extension effectively limited plant height in Poinsettia so that retailer specifications were met at market date, despite a 90% reduction in plant growth regulator (PGR) use. RDI-treated plants were also more tolerant of chilling stress, and leaf and bract drop during shelf-life tests were reduced by 50% and 90% respectively, compared to well-watered control plants that received the commercial PGR programme. Once the RDI technique had been optimised, these benefits were delivered over two consecutive seasons in 2006 and 2007.

Further work funded by the AHDB, led by the University of Lincoln and carried out at Neame Lea Nurseries in 2017/18 and 2018/19 demonstrated that Deficit Irrigation (DI) could be successfully used as a non-chemical means of growth control at scale on a commercial poinsettia crop. However, despite this and earlier successes, several barriers to the widespread commercial uptake of DI and RDI remained, and the industry felt that more convincing evidence of the potential benefits of using these approaches as a non-chemical method of growth control was needed.

In this project, we are working with our industry partners to develop tools, approaches and technologies to deliver DI and Regulated Deficit Irrigation (RDI) in a range of production systems currently used by small-, medium- and large-scale protected pot and bedding growers. New technologies and approaches are needed to enable DI and RDI to be scaled-up to deliver non-chemical growth control to 40,000+ poinsettia plants at Neame Lea Nurseries. Experiments are being carried out at Staplehurst Nurseries to provide unequivocal evidence of the benefits of RDI for height control, quality at dispatch and shelf-life potential of key pot and bedding species.

A key aim is to develop objective criteria for the assessment of plant quality at dispatch, following transport and during shelf-life tests to ensure that quality attributes are viewed consistently across the industry.

A Project Exploitation sub group (PESG) has been assembled to identify opportunities for KE exchange between different sectors, and will seek to commercialise the outputs from this project and develop further R&D proposals supported by evidence gained from exploratory studies.

Summary

To quantify the effects of deficit irrigation on poinsettia growth, quality and shelf-life potential.

The potential of using RDI to control stem extension, meet retailers' quality specifications at dispatch, and extend shelf-life potential, was investigated on a commercial crop of "Hera" poinsettia at Staplehurst Nurseries, Kent, planted in Week 29. Six irrigation blocks each consisting of four flood-and-drain benches were randomly allocated to either a Commercial Control treatment or an RDI treatment. Decisions on when to apply PGRs and irrigation events to the Commercial Control plants were scheduled by the Staplehurst grower team. Following a single application of PGR at pinching, no further sprays were applied to the RDI crop. RDI was applied during a specific development stage (see below) and during this period, the frequency of irrigation events to the RDI-treated plants was determined by NIAB EMR staff. Otherwise, irrigation events to the RDI-treated crop were scheduled by the grower team.

In early September 2019, moisture sensors were placed into nine pots sited across a bench within an irrigation block in both the Commercial Control and RDI treatments. Sensors were wired to Advanced Dataloggers with telemetry and substrate moisture content readings from individual sensors were averaged every 15 min within treatments and uploaded into a Cloud Report and displayed on a data dashboard. A weather station also provided real-time estimates of Vapour Pressure Deficits in the glasshouse to be calculated. The NIAB EMR team used these real-time data sets to impose the RDI treatment from 16 September 2019 to 10 October 2019, although frequent visits to site were made to make measurements of plant height, substrate moisture content, pore E.C. and plant-and-pot weights. During this time, four drying cycles were imposed on the RDI crop, with a target lower substrate moisture content of 10-12% before pots were re-irrigated. Nine fertigation events were applied to the Commercial Control during this period; the duration of irrigation events was the same in both treatments.

Measurements of plant height were made once or twice weekly on six labelled plants within the Commercial Control and RDI irrigation blocks by the grower team. More detailed

measurements of plant height were made weekly by the NIAB EMR team. Height data were plotted using a poinsettia growth model used by the nursery. When measured after the end of the RDI treatment on 10 October 2020, the average height of RDI-treated plants was 26.5 ± 0.6 cm, compared to an average Commercial Control plant height of 27.7 ± 0.9 cm.

To establish criteria to objectively assess quality at dispatch, after distribution and during shelf-life

Criteria for the assessment of quality at dispatch were agreed with the Project consortium and were used by the Staplehurst grower team to ascribe an overall quality score to each plant. At dispatch, several parameters were measured on randomly selected plants from each treatment, including plant height, canopy width, number of primary and secondary bracts, vertical distance between uppermost and lowermost primary bracts, width of the largest and smallest bract star, the stage of cyathia development, and the number of leaves on the basal 5 cm of stems.

The only significant difference was the number of primary heads in the Commercial Control plants (5.6) compared to the RDI-treated plants (4.8). The width of the largest bract star in the RDI-treated plants (26.2 cm) was greater than that in Commercial Controls (24.6 cm) but not significant. Overall, plant quality at dispatch was similar in the two treatments. Average plant heights in the two treatments were similar (CC = 30.2 cm, RDI = 28.9 cm) and these results confirm that effective height control can be achieved using RDI, despite a reduction in PGR use of 85% (1 vs 7 sprays) compared to the Commercial Controls.

After assessment at the nursery, twelve plants from each treatment were selected by the Staplehurst grower team for shelf-life tests. These plants were labelled, sleeved, placed in trays in boxes and transported by car on the same day to the shelf-life facility at Neame Lea Nurseries. Dataloggers were placed inside the boxes to record conditions during transport and relocation.

Criteria for the assessment of plant quality during shelf-life tests were developed by Hilary Papworth (NIAB) and Harry Kitchener (Consultant) following discussions with the grower partners. The nomenclature and scoring system to be used to try to assign objective quality scores were agreed and used to assess whether RDI impacted on the deterioration of plant quality during an eight-week shelf-life test. The quality criteria are given in the Science Section.

On arrival, the Staplehurst plants were transferred to a new purpose-built shelf-life room at Neame Lea Nurseries. Plants were removed from boxes and positioned on tables in their sleeves. One week later, on 17 November 2019, the sleeves were removed, and plant pots

were placed in saucers and re-arranged into in a pre-randomised order so that only the NIAB EMR team knew which plant had received which treatment. Twenty-four hours later, plant quality attributes were jointly assessed by the NIAB project team, Harry Kitchener, and the Neame Lea quality assurance team using the newly developed criteria. Plants were rewetted to 550 g once plant-and-pot weight fell to 350 g. Quality attributes were assessed weekly until 8 January 2020 when the shelf-life test was ended.

Over the 8-week shelf-life test, leaf drop was reduced by 50% in plants previously treated with RDI compared to Commercial Controls, and bract drop was reduced by 90% in RDI-treated plants. Cyathia development was delayed by RDI until week 4 after which values were the same in each treatment. Overall plant quality was higher in RDI-treated plants on five of the seven measurement dates, and plants previously exposed to RDI were aesthetically superior to the Commercial Controls when viewed by the attendees of the Open Day on 15 January 2020.

To scale-up the DI approach to deliver non-chemical growth control to a commercial poinsettia crop.

Deficit Irrigation was applied to blocks of approximately 2,000 “Astro Red”, “Freya Red” and “Infinity Red” plants on flood-and drain benches at Neame Lea’s Horseshoe Road site. Sensor technologies were installed on 10 September 2020, and real-time data sets were used to schedule the application of DI to the three varieties. Since site visits by the NIAB EMR team were limited, irrigation decisions during the period of DI were made in conjunction with the grower team who were monitoring the crops regularly. Plant heights were recorded using the AHDB tracker software and shared twice weekly with the NIAB EMR team.

The DI treatment was imposed from 5 October until 4 November 2020 during which time four drying and re-wetting episodes were applied. A target lower substrate volumetric moisture content of approximately 12-13% was used. At the beginning of November, concerns were raised by the Neame Lea growing team that some plants were still wilting despite the substrate moisture content having been returned to well-watered values. On a visit to the Horseshoe Road site on 8 November 2020 by the NIAB EMR team, it was apparent that the DI treatment had caused significant lower leaf fall in Freya Red, and the quality of the Astro Red and Infinity Red was also reduced. Upon examination, it was noted that the root systems in each of the varieties were not well developed, and were especially poor in Freya Red. Although height specifications were met at dispatch, the grade-out of DI-treated plants was higher than expected. Reasons for the relatively poor root development in some commercial crops at the Neame Lea Horseshoe Road site in 2019 are not known.

To deliver effective knowledge exchange, knowledge transfer and training.

The results of the 2019 experiments at Staplehurst and Neame Lea Nurseries were presented at the Poinsettia Open Days held at Neame Lea Nurseries on 9 November 2019 and 15 January 2020. Results from the 2019/20 shelf-life tests were also presented and demonstrated at the latter event. Covid-19 restrictions meant that physical meetings were no longer possible from March 2020. An article describing the aims and objectives of the project was prepared for the AHDB News in September 2020, and a presentation on how to implement RDI and what to expect was made at the AHDB Webinar on Growth Control on 15 September 2020.

Financial Benefits

The costs of the sensors from Delta-T are:

- WET sensor with HH2 hand-held meter has a list price of £1303. This will measure substrate volumetric moisture content, temperature and pore E.C. It can be calibrated for different substrates to ensure accurate VMC readings. This has been routinely used across multiple projects, and many soft fruit farms use this sensor too.
- SM150-sensor with hand-held reader is £393. This will measure substrate volumetric moisture content only. This is a read only meter – i.e. no download or record function or capacity to install substrate specific calibrations.

Cost savings in the purchase and application of PGRs are anticipated if the project is successful and a commercial RDI scheduling service is developed for pot and bedding plant growers.

A partial cost/benefit analysis of using RDI as a non-chemical means of growth control will be prepared by the Project Exploitation Sub Group (PESG) and presented in the Final Project Report.

Action Points

For growers wishing to reduce plant variability at dispatch by optimising irrigation scheduling:

- Check that your benches are level – using either a laser levelling system or water on the benches;
- Check that bench trays and channels are clean – to ensure an even distribution of irrigation water;
- Check that drainage holes are clean, with mesh grids in place – to avoid blockages and over wetting the substrates;
- Carry out annual irrigation system performance audits - to identify and resolve issues

- Measure the volume of water delivered at each irrigation event - to calculate minimum irrigation durations;
- Deploy pressure-regulated irrigation inputs wherever possible - to ensure that target irrigation volumes are accurate and precise;
- Understand the different phytoclimates in your growing areas - use the information to inform decision-making on irrigation scheduling:

For growers considering testing the potential of using RDI as a means of non-chemical growth control:

- Aim to impose RDI during the exponential phase of stem extension,
- Avoid applying RDI after week 42-43 when bracts are beginning to expand
- Reduce substrate moisture contents gradually over 2 weeks to allow plants to adapt to the drying rootzone conditions;
- During RDI, withhold irrigation until some plants begin to wilt;
- Use an inexpensive electronic balance to inform irrigation scheduling under RDI;
- Try to avoid imposing RDI during very hot weather;
- Be prepared to see some wilting plants, and a temporary change in leaf colour;
- After the RDI phase, aim to return substrate moisture content to pre-stress values within 1 week.

