# Growing media developments in ornamentals production

**New Milton Town FC, Fawcetts Field, Christchurch Road, New Milton, BH25 6QB**

**Double H Nurseries Ltd. 195 Gore Rd, New Milton, Hampshire, BH25 5NG**

**10 July 2019**

**A workshop based on output from project CP 138 '*Transition to responsibly sourced growing media use within UK Horticulture*'**

Department for Environment Food & Rural Affairs

ADAS

AHDB

# *Event programme*

| Time | Subject | Speaker |
|---|---|---|
| *10:00* | ***Coffee, tea and registration at New Milton Town FC, BH25 6QB*** | |
| 10:30 | Nursery overview and the growing media requirements of Double H Nurseries | Howard Braime, Double H Nurseries |
| 10:35 | **Introduction to CP 138**<br>• Practical aims of the project and implications for industry | Chloe Whiteside, ADAS |
| 10:50 | **Growing media blends: an overview of the ornamentals trials from 2016 - 2018**<br>• Demonstration of growing media blends and raw materials, summary of physical properties, overview of trial at Double H Nurseries and update of results | Chloe Whiteside and Dr Sonia Newman, ADAS |
| 11:30 | **Plant nutrition**<br>• How plants affect growing media pH and how that can influence choices for nutrient application | Hilary Papworth, NIAB |
| *12:00* | ***Coffee and tea break*** | |
| 12:15 | • The basics of pot plant nutrition, in relation to fertiliser choice, delivery method and assessment of effects | Neil Bragg, Bulrush Horticulture |
| *13:15* | ***Lunch, then drive to Double H Nurseries, BH25 5NG*** | |
| 14:15 | **Mechanical handling of growing media**<br>• An update on how prototype blends from CP 138 have performed when used with various machinery - bale breaking, tray filling machines etc. | Chloe Whiteside, ADAS |
| 14:30 | View of trials and nursery tour | All |
| 15:45 | Questions and answers | All |
| *16:00* | *Close and depart* | |

# *Contents*

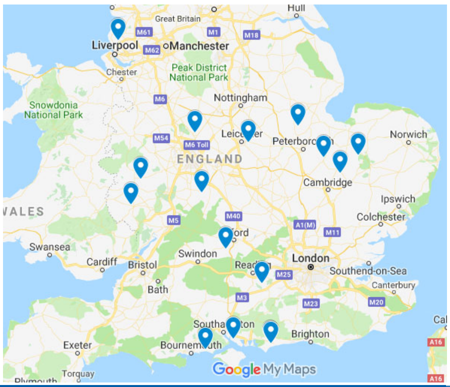
# Introduction to CP 138

*Chloe Whiteside, ADAS*

**Transition to responsibly sourced growing media use within UK horticulture (CP 138)**

Dr Barry Mulholland (ADAS), Dr Andrew Watson (QIB), Chloe Whiteside (ADAS), Dr Sonia Newman (ADAS), Ryan Hickinbotham (ADAS) and Julian Davies (STC)

## CP 138 Nursery locations

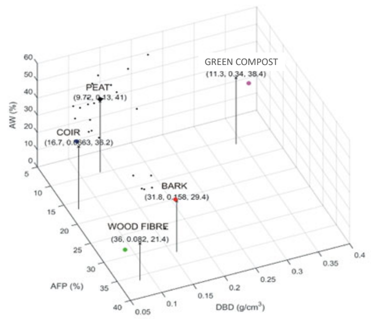


# Introduction to CP 138
*Chloe Whiteside, ADAS*

## CP 138 Aims

- To construct a model that will produce the desired mixes at least cost.
- To evaluate responsibly sourced growing media blends as alternatives to peat in commercial crop production systems.
- By on-site demonstration and effective communication of the scientific evidence base, increase grower confidence to facilitate the uptake of responsibly sourced growing media for commercial horticulture.

## Physical variables




Mulholland et al. (2016) Technical monograph: Growing Media Laboratory Methods. ©ADAS, ISBN 978-1-5262-0393-9, 24 pp.

Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

**Transition to responsibly sourced growing media use within UK horticulture (CP 138)**

Dr Barry Mulholland (ADAS), Dr Andrew Watson (QIB), Chloe Whiteside (ADAS), Dr Sonia Newman (ADAS), Ryan Hickinbotham (ADAS) and Julian Davies (STC)

AHDB | Department for Environment Food & Rural Affairs | BULRUSH | Sinclair | ICL Where needs take us | BORD NA MÓNA Naturally Driven | Quadram Institute Science + Health + Food + Innovation | Stockbridge | ADAS

## Project Overview
## RSGM Grower Trials 2016

**On-site growing media testing and development**
**Commercial products**

ADAS

### RSGM grower trials 2016 – commercial products

| Host | Trial | Duration |
|---|---|---|
| Bordon Hill & Bagintons | Bedding | Sown week 16, transplanted week 23 |
| G's | Lettuce spring | Sown week 14, harvested week 26 |
| G's | Lettuce early summer | Sown week 26, harvested week 35 |
| G's | Lettuce late summer | Sown week 32, harvested week 43 |
| New Farm Produce | Strawberries | Planted week 12. Overwintered into 2017 |
| Vitacress | Herbs spring | Sown week 13, harvested week 20 |
| Vitacress | Herbs summer | Sown week 31, harvested week 37 |
| Vitacress | Herbs autumn | Sown week 42, harvested week 49 |
| Wyevale | HNS finals | Planted week 13 – 20. Overwintered into 2017 |
| Wyevale | HNS liners | Planted week 16 – 22. Overwintered into 2017 |
| Wyevale | HNS propagation | Planted week 45. Overwintered into 2017 |

Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

## Propagation – Bordon Hill Nurseries 2016

- *Begonia semperflorans* 'Heaven Red' sown week 16, 230 trays.
- Pansy Matrix 'Yellow Blotch' sown week 17, 230 trays.
- Transplanted week 23, assessments pre-transplant and in week 27.
- One peat-reduced product and one peat-free from each manufacturer.

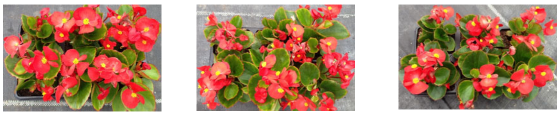
Pansy 'Matrix Yellow Blotch', week 22 – control (left), peat-reduced (middle) and peat-free (right)

ADAS

## Marketability assessment – (week 27, 2016)

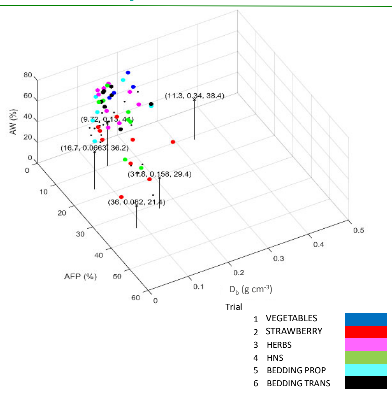
There was no significant difference between any of the treatments for height, quality or number of plants in flower at the final assessment in week 27. All plants were of marketable quality and the majority were in flower.

**Pansy Matrix 'Yellow Blotch', week 27 – control (left), peat-reduced (middle) and peat-free (right)**



***Begonia semperflorens* 'Heaven Red', week 27 – control (left), peat-reduced (middle) and peat-free (right)**

## Commercial blend analysis




ADAS

Growing media blends: an overview of the ornamentals trials from 2016 – 2018
*Chloe Whiteside and Sonia Newman, ADAS*

## RSGM Prototype Blend Trials 2016

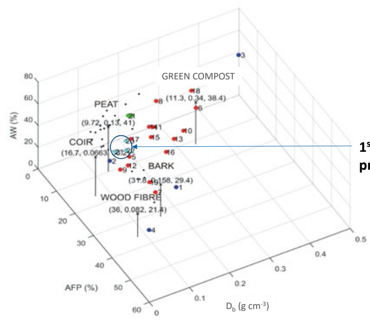
**Experimental trials ADAS Boxworth**
**First generation prototype blends**

ADAS

## Protected ornamentals trials

| | 2016 | 2017 | 2018 |
|---|---|---|---|
| Nursery |  **Bordon Hill & Bagintons** Commercially available blends |  **Ivan Ambrose** 1st prototype blends |  **Newey Roundstone** 2nd prototype blends |
| Exp. |  **ADAS** 1st prototype blends |  **ADAS** 2nd prototype blends |  **ADAS** 3rd prototype blends |

## First generation prototype blends 2016




1st generation prototype blends

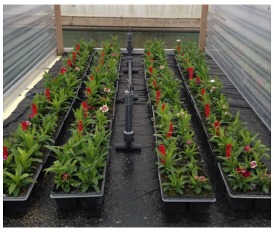
ADAS

# Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

## Pack bedding 2016 – ADAS Boxworth

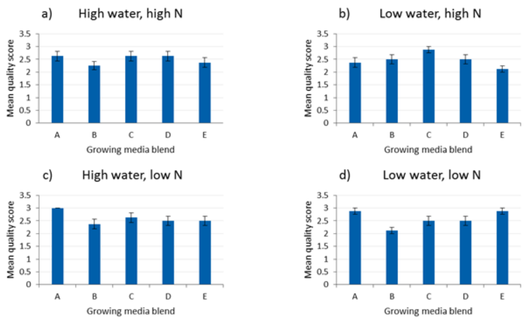
- *Viola* 'Spring Select Mixed' and *Dianthus* 'Festival Mixed'.
- Plug plants supplied by Ivan Ambrose & Co Ltd in week 27 and transplanted into 4-packs.
- Five growing media treatments:
  - 1 x peat control
  - 4 x peat-free prototype blends
- Two irrigation treatments (high and low) and two nitrogen levels (100 ppm N and 250 ppm N).
- Packs watered via overhead sprinkler.
- Assessments in week 31 for height, quality, root development and flowering.



***Dianthus* week 30, 2016**

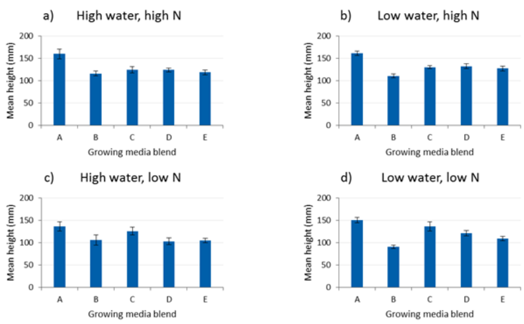
ADAS

## Quality assessment - *Dianthus* (week 31, 2016)




Differences across treatments are statistically significant ($p = 0.024$).

## Height assessment - *Dianthus* (week 31, 2016)



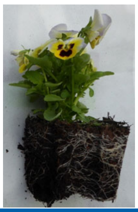

Differences across treatments are statistically significant ($p < 0.001$).

# Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

## Prototype blend testing - Boxworth 2016 summary

- For *Dianthus*, the three blends predicted to be similar to peat produced plants that were of a similar quality to those grown in the peat control.
- *Viola* plants performed poorly in the outlier B blend, this is likely as a result of high irrigation rates and the growing media not drying back.
- No visible nutrient deficiencies were noted in either species at any level, suggesting no need for extra N in the feed in the three blends brought forward for 2017.


Outlier blend B, high water, high N – week 31


Prototype E, high water, high N – week 31



## RSGM Prototype Blend Trials 2017

**Grower trials**
**First generation prototype blends**

## RSGM grower trials 2017 – first generation prototype blends

| Host | Trial | Duration |
|---|---|---|
| Ivan Ambrose | Bedding | Planted week 21, harvested week 24 |
| Frank P Matthews | Fruit tree propagation | Planted week 12. Overwintered into 2018 |
| EU Plants | Strawberry propagation | Planted week 28. Overwintered into 2018 |
| EU Plants | Raspberry propagation | Planted week 15. Overwintered into 2018 |
| Lincolnshire Herbs | Herbs spring | Sown week 14, harvested week 19-20 |
| Lincolnshire Herbs | Herbs autumn | Sown week 35, harvested week 41 |
| Lowaters | HNS | Planted week 11-22. Salvia harvested week 22. Other species overwintered into 2018 |
| G's | Mushrooms | Commenced week 29, harvested week 32 |

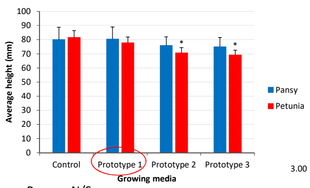
# Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

## Pack bedding 2017 – Ivan Ambrose & Co Ltd

- Two species: Pansy Matrix 'White Blotch' and Petunia 'Blue'.
- Transplanted into polystyrene double 6-packs in week 21, 2017.
- Four growing media treatments:
  - 1 x peat-reduced nursery standard mix, as a control
  - 3 x peat-free prototype blends
- Standard nursery irrigation and nutrition regime.
- Plants monitored daily by nursery staff for date of flowering, and any watering issues.
- Assessments completed in week 24, 2017 for height, quality, root development and flowering.

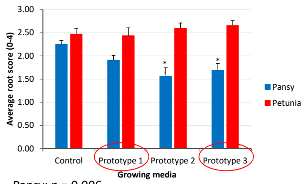
## Pack bedding 2017 – Ivan Ambrose & Co Ltd




Pansy = N/S
Petunia: p = 0.005

- There was little difference between treatments for plant quality and number of plants in flower.

Prototype 1

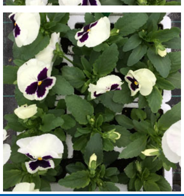



Pansy: p = 0.006
Petunia = N/S

## Pack bedding 2017 – Ivan Ambrose & Co Ltd

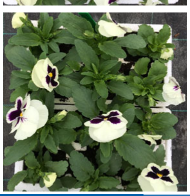
Nursery control

Prototype 1



Prototype 2

Prototype 3



Growing media blends: an overview of the ornamentals trials from 2016 – 2018
*Chloe Whiteside and Sonia Newman, ADAS*

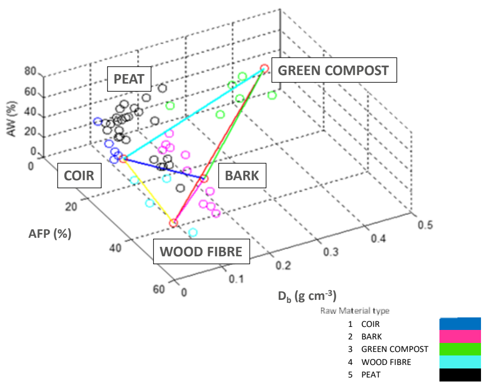
## Prototype blend testing - Ivan Ambrose 2017 summary

- All three prototype blends produced crops of both pansy and petunia which were comparable to the nursery peat-reduced control in terms of plant quality and flowering.
- There were no significant differences between prototype 1 and the control, for either bedding species. Prototype 1 was the strongest performing blend.

## RSGM Prototype Blend Trials 2017

**Experimental trials ADAS Boxworth**
**Second generation prototype blends**

## Second generation prototype blends 2017



# Growing media blends: an overview of the ornamentals trials from 2016 – 2018

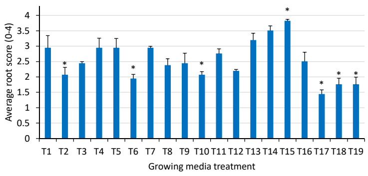
*Chloe Whiteside and Sonia Newman, ADAS*

## Pack bedding 2017 – ADAS Boxworth

- Prototype blends mixed up at ADAS Boxworth.
- One species: Pansy 'Karma'.
- Plug plants supplied by Newey Roundstone in week 34 and transplanted into 10-packs.
- Nineteen growing media treatments:
  - 1 x peat control
  - 18 x peat-free prototype blends
- Packs set down on one bench and watered via overhead sprinkler.
- Assessments completed in week 40 for height, quality, root development and flowering.

ADAS

## Pack bedding 2017 – ADAS Boxworth




* significantly different to control (p <.001)

- Mix 15 was the only treatment not significantly different to the control for height.
- Mix 14 & 15 were not significantly different to the control for quality.

Peat control (left) and mix 15 (right)

## Prototype blend testing - Boxworth 2017 summary

- There were significant differences in the performance of the pansies grown in the different growing media mixes.
- However, there were a range of good blends with no one blend outperforming the others in all assessment criteria.
- T14 and T15 produced marketable quality plants with good rooting in the pack.

ADAS

# Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*



## RSGM Prototype Blend Trials 2018

**Grower trials**
**Second generation prototype blends**

## RSGM grower trials 2018 – second generation prototype blends

| Host | Trial | Duration |
|---|---|---|
| Newey Roundstone | Summer bedding | Planted week 19 and 21, finished week 24 |
| Newey Roundstone | Autumn bedding | Planted week 39, finished week 44 |
| Delflands | Veg propagation | Sown week 36 and 38, finished week 41 |
| EU Plants | Strawberry propagation | Planted week 28. Continuing into 2019 |
| EU Plants | Raspberry propagation | Planted week 17. Continuing into 2019 |
| Darby Nursery Stock | HNS liners and finals | Planted week 20. Lavender finals finished week 40. Other species finished week 17 2019 |

## Pack and pot bedding 2018 – Newey Roundstone

- Four species in summer: Fuchsia 'Snowcap', 'Rose' and 'Shrimp Cocktail', and Pelargonium 'Savannah' in 10.5 cm pots and Petunia 'Frenzy' and Pelargonium 'Cabaret' in 10-packs.
- Transplanted into pots in week 19 and packs in week 21.
- One species in autumn: Pansy 'Inspire' in 10-packs, transplanted week 39
- Six growing media treatments:
  - 1 x peat-reduced nursery standard mix
  - 5 x peat-free prototype blends
- Standard nursery irrigation and nutrition regime.
- Plants monitored daily by nursery staff for date of flowering, and any watering issues.
- Assessments completed in week 24 and 44 for height, fresh weight, quality, root development and flowering.

## Newey Roundstone 2018 - bedding plants

Nursery standard

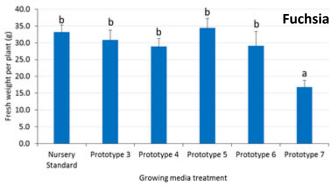
Prototype 4

Prototype 6

Prototype 7

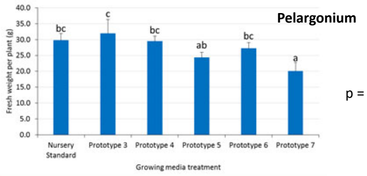
## Newey Roundstone 2018 - bedding plants

**Pot trial fresh weight, week 24**




p = 0.006

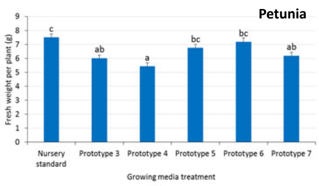
No significant differences in quality or number of plants in bud / flower




p = 0.005

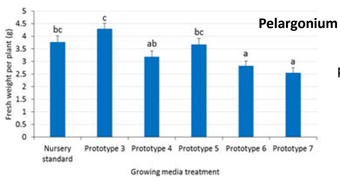
## Newey Roundstone 2018 – bedding plants

**Pack trial fresh weight, week 24**



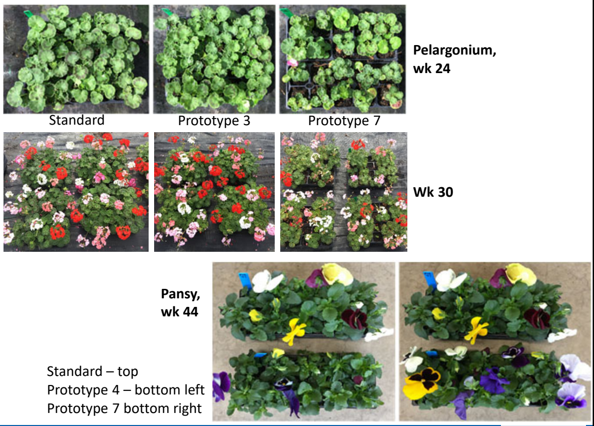

p = 0.009

Wk 44 pansy fresh weight N/S




p = 0.002

Quality differences significant in pelargonium only




## Prototype blend testing - Roundstone 2018 summary

- Prototypes 3, 4, 5 and 6 all produced good quality marketable plants, in both pots and packs, in the summer and autumn trials.
- There were no effects on flowering time, or flower size, from any of the treatments.

# RSGM Prototype Blend Trials 2018

**Experimental trials ADAS Boxworth**
**Third generation prototype blends**

Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

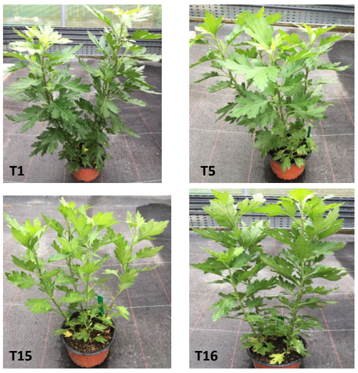
## Third generation prototype blends 2018

| Sector | Experimental trial 2018 | Grower hosted trials 2019 |
|---|---|---|
| Protected ornamentals | Boxworth | Double H |
| Hardy nursery stock | Boxworth | James Coles and Sons |
| Herbs | Boxworth | Vitacress |

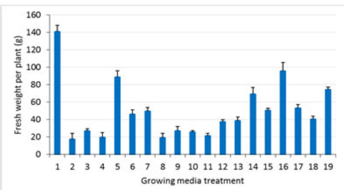
- Third generation blends have been designed to really test the model.
- 'Novel' materials that were not available to the project team in 2015 were characterised for their physical properties, and 18 blends were tested at ADAS Boxworth.

## Pot chrysanthemum 2018 – ADAS Boxworth

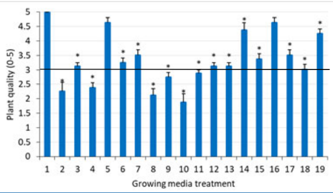
- Chrysanthemum 'Chrystal Blanche' in 14cm pots.
- Cuttings stuck in week 24.
- Ebb and flood.
- Assessed at 4, 7 and 10 weeks after sticking.
- Root development and fresh weight assessed in week 34.
- Sub-sample placed into shelf life for 2 weeks.




## Pot chrysanthemum 2018 – ADAS Boxworth




**Fresh weight:**
all treatments significantly different to the peat control (p <.001)




**Quality:**
* = significantly different to the peat control (p <.001)

## Growing media blends: an overview of the ornamentals trials from 2016 – 2018

*Chloe Whiteside and Sonia Newman, ADAS*

### Prototype blend testing - Boxworth 2018 summary

- This trial was designed to start testing the model, by taking materials which were new to the project team, and designing growing media blends based purely on their physical properties.
- It was anticipated that some blends would perform better than others.
- This was evident in the trial, some blends did not work, but there were some good results with suitable blends to take forward into 2019.

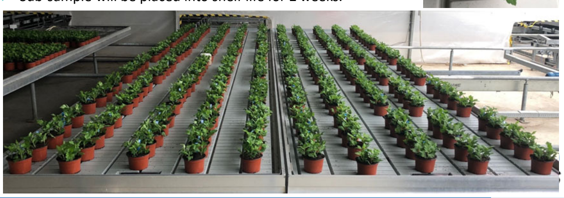


### RSGM Prototype Blend Trials 2019

**Grower trials**
**Third generation prototype blends**

### Pot chrysanthemum 2019 – Double H Nurseries

- Chrysanthemum 'Mount Aubisque Pink' in 14 cm pots.
- Cuttings stuck in week 20. Pots filled using the nursery potting machine.
- Covered with polythene for 2 weeks and then spaced.
- Ebb and flood.
- Assessments at 2, 4, 6 and 8 weeks after sticking.
- Fresh weight shall be assessed at the end of the trial.
- Sub-sample will be placed into shelf life for 2 weeks.

## Mechanisation 2018 – Mechanical Botanical

- 500 L of each prototype blend tested in a potting machine (2 L pots) and a tray filling machine (84-cell trays).
- Blends tested in their raw state, then wetted up and re-tested.
- No issues with the potting machine.
- Prototype 4 caused some issues with the tray filling machine, with the material clogging up the recycling section of the machine.
- Further testing will be completed in 2019.

ADAS

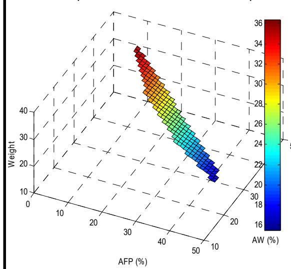
## Trials summary so far

- Trials have shown that it is possible to grow a range of bedding plants, in both pots and packs, using different peat-free materials, and different growing systems.
- Each of the prototype blends have performed well on grower holdings, most of which are generally set-up for growing in peat-reduced media. With optimal irrigation and nutrition it is likely these blends would perform even better.
- Trials are demonstrating that taking a modelling approach, and blending raw materials based on their physical properties can result in a blend which is suitable for growing plants in. This is particularly noticeable in the 2019 grower trials.
- Mechanisation testing has not revealed any major issues when utilising peat-free blends in potting machines and tray filling machines.

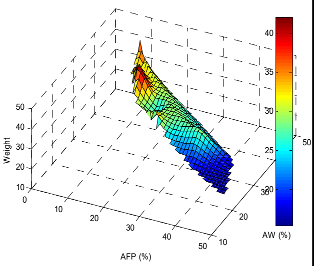
ADAS

## Developing the model

- All the data gathered so far goes into developing the model.
- The model will be a useful tool which can be used to develop growing media blends with particular characteristics to produce plants of a certain specification.




Predicted fresh weight Chinese Cabbage




Actual fresh weight (mean) Chinese Cabbage

## Acknowledgements

- Bord na Mona Plc
- Bulrush Horticulture Limited
- ICL UK & Ireland
- Sinclair
- Bordon Hill
- Baginton Nursery
- Ivan Ambrose & Co.
- Newey Roundstone
- Double H Nurseries
- ADAS Scientific Support Team
- Defra
- AHDB Horticulture

## Thank you for listening

@GrowMediaADAS

# How plants affect growing media pH and how that can influence choices for nutrient application

*Hilary Papworth, NIAB*

NIAB

How plants affect growing media pH and how that can influence choices for nutrient application

Hilary Papworth

AHDB

NIAB

## Introduction

- Nutrient Management Guide (RB 209) recommendations for protected ornamentals, bulbs and outdoor flowers
- Funded by AHDB, (project number PO BOF 003)
- Currently in year one of a four year project
- Output - improved nutrient management guidance for key crop types and growing systems within protected ornamental, bulb and outdoor flower production, generation of new information to update and enhance the ornamentals section of the AHDB nutrient management guide

NIAB

## Project work packages

- Determine the effect of different factors (irrigation system, pot size and growing medium type) on nutrition delivery in pot and bedding plants
- Establish feeding requirements for different plant growth stages when using 'one size fits all' irrigation systems and plant growth regulators
- Determine best practice nutrition delivery in hydroponics systems, including EC and pH specific to different crops
- Investigate the effects of nitrate ($NO_3$) versus ammonium ($NH_4$) based fertilisers / plant nutrients on plant growth and quality
- Determine best practice for managing groups of plants including i) holding plugs, ii) nitrogen application to field-grown narcissus in relation to stem length, base rot and NVZ restrictions
- Reduce primrose leaf edge scorch through improved boron and calcium nutrition
- Determine best practice for nutrient and plant monitoring, including imaging using infra-red or normal cameras

# How plants affect growing media pH and how that can influence choices for nutrient application

*Hilary Papworth, NIAB*

## Project work packages

- Determine the effect of different factors (irrigation system, pot size and growing media type) on nutrition delivery in pot and bedding plants
- First of several trials is underway
- 3 irrigation types x 3 peat-reduced mixes
- Petunia in 1 litre pots

## Project work packages

- **Investigate the effects of nitrate ($NO_3$) versus ammonium ($NH_4$) based fertilisers / plant nutrients on plant growth and quality**

## How plants affect growing media pH and how that can influence choices for nutrient application

- Summary current knowledge
- How this impacts project
- What more do we need to know?

# How plants affect growing media pH and how that can influence choices for nutrient application

*Hilary Papworth, NIAB*

NIAB

- Plants have the ability to change the growing medium pH during growth
- Achieved by unequal uptake of nutritive cations ($NH_4^+$, $Ca^{2+}$, $Mg^{2+}$, $K^+$) and anions ($NO_3^-$, $Cl^-$, $H_2PO_4^-$)
- And excretion by the root of an equal amount of oppositely charged ions
- Outcome is a change in pH over time

Haynes, R.J. (1990). ; Lea-Cox *et al.*, 1996; Marschner, 1995; Johnson *et al* 2013; Dikerson and Fisher, 2017

NIAB

- Different crop species during commercial production differ in how they affect growing media pH, even when supplied the same fertiliser and growing conditions
  - Geraniums (*Pelargonium*) lower growing medium pH over time - susceptible to iron and manganese toxicity at lower pH
  - Petunia tends to increase growing medium pH - susceptible to iron and manganese deficiency at higher pH
  - *Impatiens walleriana* has an intermediate affect to geranium and petunia - not as sensitive to developing nutrient disorders

NIAB

- Nitrogen form has a large impact on cation-anion uptake
- Adjusting the $NH_4^+$:$NO_3^-$ ratio in fertiliser solutions is a strategy to manage pH in the growing medium
- Nitrogen typically represents 70-80% of total mineral nutrient uptake
- Nitrogen supplied either as a $NH_4^+$-N cation or $NO_3^-$-N anion
- Plants supplied with $NH_4^+$- N generally take up more cations and lower pH
- Plants supplied with $NO_3^-$-N typically take up more anion and increase pH

How plants affect growing media pH and how that can influence choices for nutrient application

*Hilary Papworth, NIAB*

## What about the growing medium?

- Experimental work carried out using peat-based growing media
- Peat-reduced and peat-free targets
- Different media, different properties, different challenges
  - Generally higher pH
  - Potential for nutritional problems
  - Can these be mitigated by better understanding of the $NH_4^+$:$NO_3^-$ ratio

## What do you need to know?

- Detailed recommendations in different peat-reduced or peat-free mixes?
- More detailed understanding about what is happening with your crop species with regard to influence on growing medium pH?
  - We want to know so it can influence the experimental work

Thank you, and please get in touch – we want to hear from you!

hilary.papworth@niab.com

**Pot Plant Nutrition – Responsibly Sourced Growing Media Workshop**

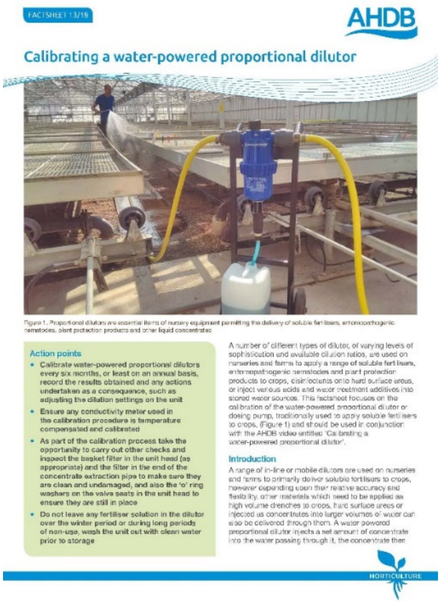
**Double H Nurseries, 10th July 2019**

# The basics of pot plant nutrition, in relation to fertiliser choice, delivery method and assessment of effects

**Facilitator: Neil Bragg**

Cultural production aspects for discussion:

1) Always have an agreed specification for the specific growing media being used - take into account the irrigation water alkalinity, crop type(s) being grown, the cropping time of production and the irrigation system in use, e.g. overhead or bench.
2) Analyse all incoming loads of growing media and build up a library of results.
3) Keep a two litre sample (minimum) of each batch of growing media - clearly labelled with batch code and date of delivery. Samples should be stored in a cool, dark area to reduce deterioration and algal growth.
4) Analyse the nursery water supply, at least six monthly checks on alkalinity. If mains water is used check once a month.
5) Water in young plant material using calcium nitrate, made up in a stock solution at 1kg in 10 litres of water and diluted and applied at 1 in 200, i.e. 0.5%. Consider 'root boosting' young plant material with applications of a high phosphate fertiliser.
6) Regular analyse the growing media during use - every three to four weeks.
7) For longer term crops, undertake leaf analyses as well - every three weeks after the first month.
8) Fertiliser selection and application method. Solid fertiliser products - applied as a base fertiliser and/or low rate CRF in the growing media mix. Water soluble fertiliser products - applied through a proportional dilutor subsequently. Which to use and when?


FACTSHEET 13/18

AHDB

Calibrating a water-powered proportional dilutor

Figure 1. Proportional dilutors are essential items of nursery equipment permitting the delivery of soluble fertilisers, entomopathogenic nematodes, plant protection products and other liquid concentrates

**Action points**

- Calibrate water-powered proportional dilutors every six months, or least on an annual basis, record the results obtained and any actions undertaken as a consequence, such as adjusting the dilution settings on the unit
- Ensure any conductivity meter used in the calibration procedure is temperature compensated and calibrated
- As part of the calibration process take the opportunity to carry out other checks and inspect the basket filter in the unit head (as appropriate) and the filter in the end of the concentrate extraction pipe to make sure they are clean and undamaged, and also the 'o' ring washers on the valve seats in the unit head to ensure they are still in place
- Do not leave any fertiliser solution in the dilutor over the winter period or during long periods of non-use, wash the unit out with clean water prior to storage

A number of different types of dilutor, of varying levels of sophistication and available dilution ratios, are used on nurseries and farms to apply a range of soluble fertilisers, entomopathogenic nematodes and plant protection products to crops, disinfectants onto hard surface areas, or inject various acids and water treatment additives into stored water sources. This factsheet focuses on the calibration of the water-powered proportional dilutor or dosing pump, traditionally used to apply soluble fertilisers to crops, (Figure 1) and should be used in conjunction with the AHDB video entitled 'Calibrating a water-powered proportional dilutor'.

**Introduction**

A range of in-line or mobile dilutors are used on nurseries and farms to primarily deliver soluble fertilisers to crops, however depending upon their relative accuracy and flexibility, other materials which need to be applied as high volume drenches to crops, hard surface areas or injected as concentrates into larger volumes of water can also be delivered through them. A water powered proportional dilutor injects a set amount of concentrate into the water passing through it, the concentrate then

HORTICULTURE

Base fertiliser products are only intended to last three to five weeks so need some sort of supplementary fertiliser. Note base fertilisers can easily be leached out, an increasing problem with some of the new physical components of the growing medium that have lower buffering capacities.

CRFs used at lower levels for some crops - consider removing base fertilisers.

Does the dilutor work appropriately? Who does the on-nursery checks and calibration? See AHDB Factsheet 13/18 '*Calibrating a water-powered proportional dilutor*'.

# Optimising and monitoring plant nutrition in poinsettia crops

Figure 1. Interveinal leaf chlorosis – a potential nutrient deficiency symptom on poinsettia

## Action points

- **Always analyse a sample of the freshly delivered growing media (using the available water-soluble nutrient analysis) to create a reference point at the start of each growing season**
- **Analyse the irrigation water each year to determine and compensate for alkalinity and nutrient loading**
- **Adopt a programme of regular growing media analyses during the growing season, at least every three weeks following potting**
- **Undertake regular tissue analysis one month after potting, focusing on calcium and phosphorus levels**
- **Around the end of August/start of September, as flower initiation commences, pay particular attention to the levels of available phosphorus in the growing media**
- **Be prepared to switch water-soluble fertiliser formulations at various growth stages during production to match the specific need of the crop**

## Introduction

The number of poinsettia plants produced per annum in the UK has fluctuated over the last 20 years or so, from a maximum of around eight million, to a low of just over two million. In recent years, total production has also been linked to the introduction of the Renewable Heat Incentive and increased adoption of biomass boilers by nurseries for heat generation. Currently, the estimated production is around five million plants, destined mainly for the multiple retailer market.

In terms of nutrition, poinsettias are one of the more demanding crops. Nutrient-related symptoms can be expressed on both leaves and bracts during both the production and marketing phases (Figure 1). Severe symptoms expressed later on in the growing season are difficult to correct and may result in substantial crop rejection and wastage.

Prior to the introduction of the Poinsettia Monitoring Scheme in 1998, several cultural issues were experienced each year, which were assumed to be linked to plant nutrition. In some cases, the symptoms appeared rapidly and, because there were only limited historical growing media and leaf tissue analytical records to interrogate, it was very difficult to fully understand the problems and take appropriate corrective action in a timely manner. Once monitoring became established and more frequent in more plant varieties, then trends in plant growth and performance could be related back to the leaf tissue analysis and the reserves remaining in the growing media, providing a greater understanding of the interactions between crop quality and nutrient availability.

## Crop nutrition programmes

Most poinsettia growers use ready-made growing media mixes that are specific to the poinsettia crop. Currently – and for several years – the favoured physical mix for the crop is one based on peat and perlite (the latter included between 20–30% by total volume). Along with lime as required, an agreed base fertiliser is added to these mixes and then subsequent plant growth relies on the application of water-soluble fertilisers. In recent years, very encouraging results have been observed in numerous trials examining peat-free growing media mixes for the crop, with improvements noted in root development.

### Base and water-soluble fertiliser regimes

Growing media manufacturers add various ingredients to the basic physical mix. Commonly, a base fertiliser, such as a 15-10-20 NPK fertiliser, is applied at a rate of 1 g/L. Lime is also included to bring the medium pH to between 5.8 and 6.4. Even in peat-free growing media mixes, poinsettias still require both calcium and magnesium, which are mainly supplied via the lime added to peat-based mixes. Therefore, an alternative strategy, using gypsum and Epsom salts in the base fertiliser mix to supply these two essential elements, may be needed in such media types.

Generally, base fertilisers give three to four weeks of overall crop nutrition, depending upon the vigour of crop growth and the frequency of irrigation.

Following potting, any initial crop nutrient demand is best supplied using calcium nitrate. Usually, a stock solution is created at a rate of 1 kg/10 L of water and this is then applied at a dilution rate of 1 in 100 (1%) at every irrigation. Calcium nitrate is very useful because (a) it ensures that the developing plant tissue has plenty of available calcium and (b) nitrogen is most easily taken up and utilised by the plants in the nitrate form, supporting the initial vegetative phase of growth. Note that fertilisers high in nitrate-N do not cause a drop in medium pH, unlike ammonium-N fertilisers, which will cause the pH of the medium to drop over time.

After the plants have been pinched back, it may be worthwhile alternating applications of calcium nitrate with a proprietary water-soluble fertiliser such as an 18-10-18, both used at half strength at every watering (0.5 kg/10 L stock solution applied at 1 in 100 (1%)). It is far better to regularly liquid feed the crop at a lower level than to apply infrequent large amounts of nutrients.

At the end of August and into the first two or three weeks of September, a lift in phosphorus levels is required to coincide with the demands of flower initiation. This is achieved by using either mono-ammonium phosphate (MAP) or a proprietary water-soluble fertiliser such as a 10-52-10. Both of these fertilisers can be used to create a stock solution at 1 kg/10 L and subsequently applied at 1 in 100 (1%).

For the remainder of the growing season, a switch to a 14-5-30 proprietary water-soluble fertiliser or similar, in which the potassium level is higher, will assist with bract and flower development and help to tone plants prior to marketing (Figure 2).

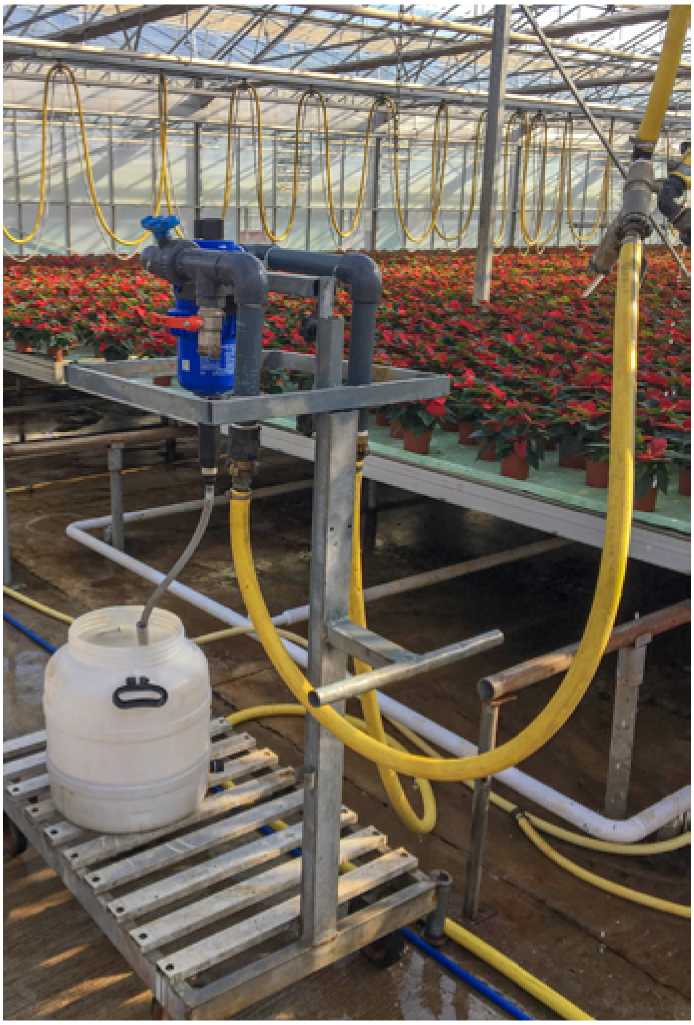


Figure 2. Liquid feeding a maturing poinsettia crop in November to ensure correct bract and flower development and to tone the plants

### Controlled release fertiliser regimes

An alternative crop nutrition strategy is to use a low level of controlled release fertiliser (CRF) incorporated into the fertiliser base mix to provide longer term nutrition. This is not widely used within the industry, because of concerns about growing media temperatures under glasshouse structures, especially during weeks 25–35, and the effect of high temperatures on nutrient release from the CRF. High media temperatures can encourage a rapid release of nutrients from the CRF granules, raising the electrical conductivity (EC) levels above those desired in the early stages of root establishment and growth. However, where CRF granules are incorporated, it is generally of the five to six month longevity-type products, at low rates between 1.5–2.5 g/L.

Analysis of the growing media during the growing season still indicates the need for additional phosphorus around flower initiation and, even when using the CRF approach, attention is also required to ensure that calcium and magnesium levels are maintained. Where the low level CRF approach is adopted, water-soluble fertilisers |should be used to supplement the crop at specific times. Towards the end of August and the beginning of September, fertilisers with a high available phosphorus content should be used to prevent the plants from mobilising phosphorus from older leaves to sustain the initiation and development of the bracts and flowers.

## Crop and input monitoring during the growing season

### Interpretation of irrigation water analysis results

Water can be categorised according to its bicarbonate content or alkalinity (Table 1). Where the bicarbonate content is low (below 125 ppm), water is categorised as soft, while above this are varying levels of hardness in which the bicarbonate content can reach over 300 ppm (for further information see Factsheet 10/16 ***Sampling methodologies and analysis interpretation for growers of hardy nursery stock***). While soft water, such as that collected from glasshouse roofs, is desirable for irrigation, it is low in calcium and magnesium. Therefore, in terms of plant nutrition, extra calcium nitrate or Epsom salts may be required where soft water is the primary source of irrigation water.

At the other extreme, irrigating crops with a hard water source is almost equivalent to applying a 'lime-wash' solution to the growing medium and this can result in an increase in medium pH, 'chalk' deposits on foliage and blockages in irrigation nozzles. Treatment with acids (most often nitric acid) breaks down calcium and magnesium carbonates and releases the elements, but will also introduce nitrate-N into the water. For example, if water has an alkalinity of 300 ppm and 60% nitric acid is used to reduce this level to 80 ppm, around 40 ppm of nitrogen will be generated. Fertiliser applications should be adjusted to take this extra source of nitrogen into account.

Table 1. Definition of water hardness and the need for treatment

| Water type | Alkalinity level (ppm or mg/l) | Need for acid treatment |
|---|---|---|
| Soft | <125 | No, but review need for calcium inputs |
| Hard | 125–200 | Worth considering |
| Very hard | 201–300 | Yes |
| Extremely hard | >301 | Essential |

High levels of boron (over 1.0 ppm) can indicate industrial contamination of the water source. High iron levels (over 0.5 ppm) can cause precipitation in irrigation equipment or leave deposits on foliage. Plants do not need great quantities of chloride or sulphate, but both will add to the overall EC of irrigation water. High chloride (and sodium levels) may indicate salinity issues with the irrigation water, and boreholes drilled into rock composed of gypsum can give rise to high sulphate levels. In extreme cases, the EC of such sulphate-rich water can be 1000–2000 µS/cm, in turn causing irrigation water containing water-soluble fertiliser to have an EC of up to 3000 µS/cm. Experience has shown that although this may seem problematic, this type of water can be used without apparent problems.

### Interpretation of growing media analysis results

It is generally accepted that poinsettias are an unforgiving crop because anything that is sub-optimal during the growing season often manifests as plant downgrading at marketing. Therefore, a thorough knowledge of the growing media used at delivery and during the growing season is essential to avoid any nutrition-related issues. Before use, always carry out an initial available water-soluble nutrient analysis of the growing media to create a reference point at the start of the growing season. As more peat-reduced and peat-free mixes are adopted, then analysis to ensure an adequate initial supply of nutrients, such as nitrate-N and phosphorus, is essential. Remember that many peat replacement mixes show a nitrogen 'draw down' as a result of microbial interactions in the media and additional nitrogen may well be needed to counter such effects.

Once in use, the growing medium should ideally be sampled and analysed every three weeks during the growing season, which, at the end of the season, equates to around six or seven samples per season. Table 2 shows the desirable pH and EC levels and quantities of various elements and nutrients that should be present in growing media sampled during production. The ranges are based on the available water-soluble nutrient analysis using the 1:5 water extraction method. For further information about this extraction method, see Factsheet 10/16 ***Sampling methodologies and analysis interpretation for growers of hardy nursery stock***.

Table 2. Interpretation of growing media available water-soluble nutrient analysis results

| Criteria/ element | Unit of measurement | Suggested desirable range* |
|---|---|---|
| pH | pH units | 5.8–6.2 |
| Electrical conductivity (EC) | µS/cm | 150–400 |
| Nitrate-N | mg/l | 80–150 |
| Ammonium-N | mg/l | 10–30 |
| Phosphorus | mg/l | 25–40 |
| Potassium | mg/l | 100–300 |
| Magnesium | mg/l | 15–35 |
| Calcium | mg/l | 50–200 |
| Sodium | mg/l | 10–30 |
| Chloride | mg/l | 30-80 |
| Sulphate | mg/l | 100–300 |

*Desirable ranges based on analysis using the 1:5 water extraction method

Key indicators to bear in mind include:

- The pH should not to fall below 5.5, but should remain in the ideal range of 5.8–6.2. Levels below 5.5 encourage the uptake of elements such as manganese, which may accumulate to toxic levels within plants
- The EC level should be between 150–400 µS/cm, but in areas with permanent hard water, high alkalinity may cause the growing media EC to rise into the 800s
- Nitrate-N should be around 80–150 mg/l
- The level of ammonium-N should always be much lower than the level of nitrate-N
- The level of phosphorus should be around 30 mg/l
- Chloride levels should normally be around 20–40 mg/l; however, if peat replacement mixes are used then the level can be as high as 150 mg/l and this can interfere with nitrate-N uptake
- Sulphate levels should generally be around 200 mg/l, but water source quality can affect this

### Interpretation of leaf tissue analysis results

Tissue taken from fully expanded leaves, avoiding the youngest and oldest leaves, provides an historical record of the nutrients the plant has taken up. In some circumstances, for example if there are odd markings or discolouration on the plant, it is worthwhile sampling leaves from the affected area, as well as obtaining a number of unaffected leaves, to permit comparison of the results. See Factsheet 10/16 ***Sampling methodologies and analysis interpretation for growers of hardy nursery stock*** for further information.

Table 3. Interpretation of leaf tissue analysis results for *Euphorbia pulcherrima* (poinsettia)

| Element | Unit of measurement | Stated historic values (based on most recently mature leaf) |
|---|---|---|
| Nitrogen | % | 4.0–6.0 |
| Phosphorus | % | 0.3–0.5 |
| Potassium | % | 1.5–3.5 |
| Magnesium | % | 0.3–1.0 |
| Calcium | % | 0.7–2.0 |
| Sulphur | % | 0.25–0.7 |
| Copper | ppm | 3.0–25 |
| Zinc | ppm | 25–100 |
| Manganese | ppm | 45–300 |
| Iron | ppm | 100–300 |
| Boron | ppm | 30–100 |
| Molybdenum | ppm | 1.0–5.0 |

Stated historic levels are available to compare the values generated by leaf tissue analysis (as presented in Table 3), but care is required here; varieties have changed since the values in Table 3 were generated and, as a result, the desirable ranges presented may vary, particularly for some of the trace elements like boron. Evidence accumulated over the 20 year duration of the Poinsettia Monitoring Scheme clearly indicates that varieties have different levels of specific elements in their leaf tissue. For example, the value for boron indicates a range of 30–100 ppm in mature leaf tissue; however, in the case of varieties examined since the late 1990s, values have been in the range of 18–25 ppm with no suggestion of any deficiency issues. This emphasises the value of local, long-term nutrient level recording efforts.

For many years, 'bract blackening' has been noted in crops, which is associated with calcium distribution in the leaf and bract tissue (Figure 3). Calcium is needed continuously in the development of a plant, even short-term interruptions in supply can cause developing cell walls to be calcium deficient, in turn leading to collapse of the developing plant tissue and bract blackening symptoms. Once calcium is fixed within the cell walls, it stays there throughout the life of the plant, hence it cannot be remobilised to the growing points. This explains why symptoms are only expressed at the growing points and bracts.

Figure 3. Bract edge necrosis, which can develop as a result of insufficient calcium

However, bear in mind that just because calcium is available in the growing medium, it doesn't mean that levels within the plant will be optimal. Calcium is passively swept into the plant roots and then the xylem transport vessels within the plant, by way of the transpiration stream, to the leaf stomata. If plants are prevented from transpiring for any length of time, then calcium uptake is restricted and – again – new tissue may suffer damage. In the case of poinsettia, the dry matter calcium content of leaves should be around 1%.

Figure 4. Phosphorus deficiency in older poinsettia leaves caused by phosphorus mobilisation

Phosphorus is an element that is heavily involved in energy transfer within plants. It is in high demand as the plant switches from vegetative growth to floral initiation. In poinsettia, flower initiation occurs from the end of August/start of September onwards, as day lengths start to shorten. If the plant is unable to access sufficient phosphorus from the growing media, it will remobilise it from older leaves, which will cause these older leaves to display interveinal chlorosis and/or purpling (Figure 4). Some varieties suffer much worse than others; for example, the variety 'Infinity' has proven particularly prone to such visual symptoms if the phosphorus level in the growing media falls to 10–20 mg/l and the tissue level is 0.5% or less dry matter content.

In the past, molybdenum deficiency was reportedly common in poinsettia crops. Molybdenum deficiency symptoms manifest as 'rabbit tracks'; white spots along either side of the leaf mid-rib. To counter this, a foliar application of sodium molybdate at 0.1 ppm was recommended. However, in recent years, with the emergence of specific poinsettia water-soluble fertilisers with slightly increased molybdenum content, the need for any additional sprays has all but disappeared. Levels in tissue appear to average around 3 ppm and this appears satisfactory for modern varieties.

For future crops, the levels of nitrogen in leaf tissue may well become an issue as peat replacement in growing media mixes continues. Levels of nitrogen in leaf tissue normally start from 2% dry matter content, with 4–5% being normal. If there are components within mixes that adsorb more nitrogen to satisfy microbial demands, or if mixes become more open structured with less buffering capacity, then nitrogen levels in tissue may fall below 1.5% and general yellowing and stunting of growth may be observed (Figure 5).

## The importance of site-specific records

As previously elaborated, standard values are a useful starting point in terms of understanding analysis results; however, the real benefit is gained from generating a record from crops grown on site. It is recommended that, at the end of each growing season, after reviewing and acting upon results, values are stored to provide an historical record of trends relative to the growing media mix used, varieties grown and the prevailing weather conditions experienced during the growing season.


Figure 5. Extreme induced nitrogen deficiency (left), as a result of nitrogen adsorption by the growing medium examined

## *Author*

**Neil Bragg** – Substrate Associates Ltd

## Further information

### AHDB Horticulture factsheets and other information

- Factsheet 13/18 ***Calibrating a water-powered proportional dilutor***
- Factsheet 10/16 ***Sampling methodologies and analysis interpretation for growers of hardy nursery stock***
- ***Bedding and Pot Plants Crop Walkers' Guide***

## Acknowledgements

Leaf tissue analysis information in Table 3 is based upon information contained within *Plant Nutrient Disorders 5 – Ornamental Plants and Shrubs*, Cresswell and Weir 1997.



Produced for you by:

**AHDB Horticulture**
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

**T** **024 7669 2051**
**E** **comms@ahdb.org.uk**
**W** **horticulture.ahdb.org.uk**
**@AHDB_Hort**

If you no longer wish to receive this information, please email us on **comms@ahdb.org.uk**

# Calibrating a water-powered proportional dilutor


Figure 1. Proportional dilutors are essential items of nursery equipment permitting the delivery of soluble fertilisers, entomopathogenic nematodes, plant protection products and other liquid concentrates

## Action points

- **Calibrate water-powered proportional dilutors every six months, or least on an annual basis, record the results obtained and any actions undertaken as a consequence, such as adjusting the dilution settings on the unit**
- **Ensure any conductivity meter used in the calibration procedure is temperature compensated and calibrated**
- **As part of the calibration process take the opportunity to carry out other checks and inspect the basket filter in the unit head (as appropriate) and the filter in the end of the concentrate extraction pipe to make sure they are clean and undamaged, and also the 'o' ring washers on the valve seats in the unit head to ensure they are still in place**
- **Do not leave any fertiliser solution in the dilutor over the winter period or during long periods of non-use, wash the unit out with clean water prior to storage**

A number of different types of dilutor, of varying levels of sophistication and available dilution ratios, are used on nurseries and farms to apply a range of soluble fertilisers, entomopathogenic nematodes and plant protection products to crops, disinfectants onto hard surface areas, or inject various acids and water treatment additives into stored water sources. This factsheet focuses on the calibration of the water-powered proportional dilutor or dosing pump, traditionally used to apply soluble fertilisers to crops, (Figure 1) and should be used in conjunction with the AHDB video entitled 'Calibrating a water-powered proportional dilutor'.

## Introduction

A range of in-line or mobile dilutors are used on nurseries and farms to primarily deliver soluble fertilisers to crops, however depending upon their relative accuracy and flexibility, other materials which need to be applied as high volume drenches to crops, hard surface areas or injected as concentrates into larger volumes of water can also be delivered through them. A water-powered proportional dilutor injects a set amount of concentrate into the water passing through it, the concentrate then mixes with the water before the water pressure pushes the solution out of the unit and into the irrigation network. The dose of the concentrate injected by the unit is proportional to the volume of water entering it. It is important to calibrate such units at least annually to ensure they are still performing within the stated tolerance, wear and tear and damage to key parts can impair their performance.

## Equipment needed to undertake the calibration procedure

The following items listed below, and shown in Figure 2, are required to undertake the procedure:

- Scales reading in one gram intervals to 2,000g (2kg), with a zeroed reading facility
- A small measuring cylinder capable of measuring up to 20ml in 5ml intervals
- A range of bottles or beakers with capacities of 500mls
- An electrical conductivity meter which has temperature compensation built into it

It is important to have calibration solutions for the electrical conductivity meter and to calibrate the meter at least every four to six months. Generally electrical conductivity meters are far more reliable and robust than pH meters.


Figure 2. Essential items of equipment that are required to undertake the calibration procedure

## Calibration procedure

First of all make up a fertiliser stock solution using any commonly available water soluble fertiliser, or use a readily available fertiliser stock solution which would normally be applied to the crops grown. For example, take a compound water soluble fertiliser such as 20-10-20 (N:P:K) and make up a stock solution containing 100g/l. Dissolving the crystalline fertiliser in the water will reduce the temperature of the solution, therefore it should be left for a short while to reach ambient temperature. If possible when making up the stock solution use warm water (say 15–20°C) to help dissolve the crystals and stir the solution continuously to ensure the fertiliser is fully dissolved.

When measuring out small amounts of liquid it is often easier and more accurate to use scales rather than go by the graduation marks on the container. As one millimetre of water equates to one gram in weight this makes the process straightforward. Zero the scales with the container on them and weigh out the corresponding amount of solution.

Weigh out 10g of the water soluble fertiliser stock solution into a small container using the small measuring cylinder. (The type of plastic measuring thimble supplied with cough medicines is accurate enough for this). Pour the measured amount of stock solution into a clean, dry beaker or bottle capable of holding 500mls plus of solution, already placed on a set of scales which have been zeroed, so that the recorded weight is 10g. Now pour in water from the nursery/farm supply until the reading on the scales is 500g. At this point the beaker contains a diluted solution of 1 in 50 (2%). Measure the electrical conductivity (EC) of the diluted stock solution just created. This will be the highest value recorded and will probably be around 2,100µS/cm$^2$ (microsiemens) or 2.1mS/cm$^2$ (millisiemens), depending upon the EC of the water used during the calibration procedure. Record the value obtained.

Take a fresh bottle or beaker and place it on the scales and again zero the reading. Weigh into this bottle 50ml of the previously diluted (2%) solution. This should read 50g on the balance. Add to this a further 50mls of the nursery/farm water supply such that the balance now reads 100g. The solution created has now been diluted to 1 in 100 (1%). Measure the EC of this solution, the value will probably be around 1,400–1,500µS/cm$^2$ or 1.4–1.5mS/cm$^2$, and record the value.

Finally, in a clean bottle or beaker, again zeroed on the scales, weigh out 50g of the previously diluted solution (1%) and add to it a further 50mls of the nursery/farm water supply. This solution will now be a dilution of 1 in 200 (0.5%). Measure the EC of this solution, which will be in a range of 700–900µS/cm$^2$ or 0.7–0.9mS/cm$^2$, and record the value.

The values can be recorded in a table as outlined in Table 1, noting the EC level recorded against each of the sequential dilution ratios.

Table 1. EC values obtained from the calibration procedure

| Dilution ratio or equivalent percentage solution | 1:50<br>2% | 1:100<br>1% | 1:200<br>0.5% |
|---|---|---|---|
| Electrical conductivity value obtained (µS/cm²) | 2,100 | 1,450 | 825 |

A graph of the data can then be plotted and used as a calibration curve (Figure 3) as follows:

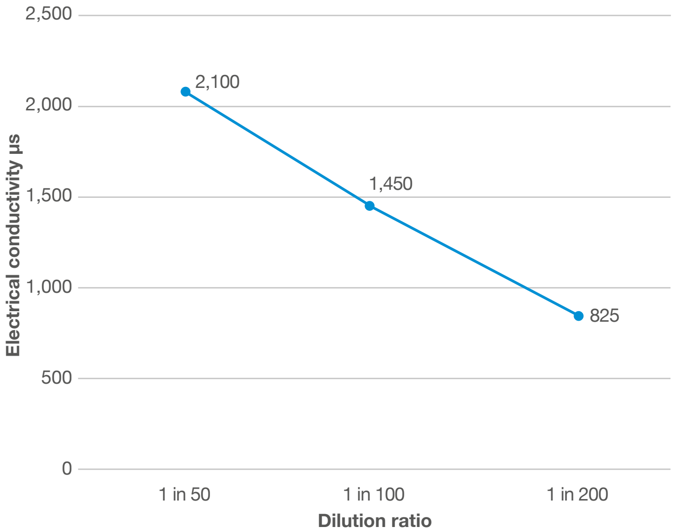



Figure 3. Example calibration curve which can be used to assess the performance of on-site proportional dilutors via the predicted EC levels

The calibration curve created can then be used to test the output of the dilutor at a specific dilution setting. Take the stock solution used to produce the calibration curve and run it through the proportional dilutor to be assessed. Collect the output solution and measure the EC of the solution and compare it to the calibration curve.

For example, at a setting of 1 in 100 (1%) on the proportional dilutor, an EC reading of 1,300µS/cm² may be obtained, where the calibration curve predicted a value of 1,450 µS/cm². To compensate for this, the dilution setting on the dilutor can be adjusted, possibly to 1 in 80 (1.25%). To check this, take a second sample and measure the EC to see if the reading is nearer to the value required. In this way the setting on the dilutor is used as an indicator and the actual accuracy is measured by the use of the EC value. Experience has shown this task to be essential, a regular check is required to verify the correct levels of soluble fertilisers (and other substances) are being applied to crops through the unit.

Note that all the values obtained include the EC of the nursery/farm irrigation water from the source used. Water in the U.K. can have EC values varying between 50µS/cm² and 1,200µS/cm², depending upon source and geographic location. The water used in the calibration procedure described had an EC of 100µS/cm², so all the values shown in Table 1 can only be used for another water source if they were first reduced by 100 and then had the new irrigation water EC value added onto them.

## Simple unit maintenance

While undertaking the calibration procedure, it is useful to consider a number of important points regarding unit maintenance:

- Where appropriate check the basket filter in the unit head (Figure 4) to make sure it is clean. It can become clogged with debris in the water source, or concentrate fertiliser crystals can develop on it during periods of low or no use. Ideally when a dilutor is not being used it should be washed out with plain water, via the concentrate feed intake tube, to remove any potential residual fertiliser solution
- Many dilutors contain small 'o' ring washers on the valve seats which close the flow when injecting the concentrate. These 'o' rings can be 'blown off' the valves if the initial water pressure exceeds the unit tolerance levels. These should be checked to make sure they are in place and not damaged. Ideally, upon commencing use of the dilutor, the flow rate of the irrigation water should be gradually increased to working pressure. When in use, the dilutor (if of the piston type) should make a steady audible 'click, click click', as the piston is driven up and down within the unit

Figure 4. Basket filter removed from the unit head of the proportional dilutor ready for cleaning

*Author*

**Neil Bragg, Substrate Associates Ltd**


## Glossary

**Electrical conductance (EC):** a measure of the ease by which an electrical current passes through a solution or substance; one millisiemen (mS) equates to one thousand microsiemens (µS).

## Further information

### AHDB Horticulture factsheets and other information

Factsheet 10/16: 'Sampling methodologies and analysis interpretation for growers of hardy nursery stock'.

Factsheet 06/07: 'Principles of strawberry nutrition in soil-less substrates'.

Factsheet 05/05: 'Nutrition of container-grown hardy nursery stock'.

Wallchart 'Strawberry analysis chart – optimum ranges'.

Transfer of INNOvative techniques for sustainable WAter use in FERtigated crops (EU funded Fertinnowa project), website address – **www.fertinnowa.com**

## Acknowledgements


The guidance in this factsheet is based on the content of Bulrush Horticulture Grower Notes GN10. Thanks also go to Russell Woodcock and Gary Woodruffe, Bordon Hill Nurseries, for their time and input into both the factsheet and video dealing with the calibration of water-powered proportional dilutors.


## Image copyright



Watch our 'how to' video for an easy step-by-step visual guide to calibrating a water-powered proportional dilutor. Available from: **bit.ly/ProportionalDilutor**


Produced for you by:

**AHDB Horticulture**
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

**T 024 7669 2051**
**E comms@ahdb.org.uk**
**W horticulture.ahdb.org.uk**
**@AHDB_Hort**




AHDB

## Notes