



Grower Summary

PO 019a

The Bedding and Pot Plant Centre – new product opportunities for bedding and pot plant growers.

Objective 1. To evaluate plant growth regulators for use on bedding and pot plants

Annual 2018

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.

©Agriculture and Horticulture Development Board 2017. No part of this publication may be reproduced in any material form (including by photocopy or storage in any medium by electronic mean) or any copy or adaptation stored, published or distributed (by physical, electronic or other means) without prior permission in writing of the Agriculture and Horticulture Development Board, other than by reproduction in an unmodified form for the sole purpose of use as an information resource when the Agriculture and Horticulture Development Board or AHDB Horticulture is clearly acknowledged as the source, or in accordance with the provisions of the Copyright, Designs and Patents Act 1988. All rights reserved.

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

AHDB Horticulture,
AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

AHDB Horticulture is a Division of the Agriculture and Horticulture Development Board.

Project title: The Bedding and Pot Plant Centre – new product opportunities for bedding and pot plant growers.

Objective 1. *To evaluate plant growth regulators for use on bedding and pot plants*

Project number: PO 019a

Project leader: Dr Jill England, ADAS Boxworth

Report: Annual report, 31 March 2018

Previous report: None

Key staff: Dr Jill England (ADAS), Senior Horticulture Consultant
Chloe Whiteside (ADAS), Horticulture Consultant
David Talbot (ADAS), Horticulture Consultant

Location of project: Baginton Nurseries, Coventry, Warwickshire

Industry Representative: Caroline Shove, Bryants Nurseries Ltd, Water Lane, Bovingdon, Hemel Hempstead, Hertfordshire, HP3 0NA

Date project commenced: 1 April 2017

Date project completed 31 March 2019

(or expected completion date):

Grower Summary

Headline

- Terpal + Activator 90 spray and drench applications reduced growth of *Begonia*, *Dianthus*, Geranium, Pansy, New Guinea *Impatiens* and *Zantedeschia* compared with the untreated control.
- Spray applications of the remaining products all controlled the growth of some species to varying degrees, in particular the spray application of HDC P005 showed promise in controlling growth of *Dianthus*.
- Drench applications of HDC P005, Moddus, Primo Maxx II, Terpal + Activator 90 and Regalis Plus reduced growth in all species, but were too strong; further trials in 2018 will refine application rates.
- EAMU 0151/18 has been issued for Terpal and 0621/18 for Primo Max II, an application has been submitted to CRD for an EAMU for HDC P005.

Background

The Bedding and Pot Plant Centre (BPPC) has been established to address the needs of the industry via a programme of work to trial and demonstrate new product opportunities and practical solutions to problems encountered on nurseries. Knowledge transfer events including trial open days and study tours are also included in the programme.

The work programme is guided by a grower-led Management Group that includes members of the BPOA Technical Committee, and representatives from Baginton Nurseries, Coventry the host nursery for the BPPC, and growers representing both the bedding and pot plant sectors.

This is the Bedding and Pot Plant Centre report for:

Objective 1. *To evaluate plant growth regulators for use on bedding and pot plants*

Summary

The evaluation of new plant growth regulators (PGRs) for use on bedding and pot plants was prompted by label changes to the plant growth regulator Bonzi (paclobutrazol), including removal of the option for drench application, and the potential loss of approval for the use of chlormequat in protected ornamental plant production. Many growers apply PGRs as sprays and drenches and have developed application rates specific to the crops they grow under the specific growing conditions on their nurseries. The PGRs included in this trial have either been trialled in Denmark with promising results on bedding and pot plants, are new to the market or have recently received CRD approval for use on related crops in the UK. However, any phytotoxic effects and efficacy of these chemicals on bedding and pot plants grown under UK conditions are currently unknown.

The active ingredients of the products included in this trial were predominately anti-gibberellins, which prevent production of gibberellin at various points in its biosynthesis. The three PGR groupings are: 1) Quaternary Ammonium Compounds (QAC) e.g. chlormequat chloride (Stabilan 750) and mepiquat chloride (a component of Terpal) which prevent gibberellin production early in its biosynthesis; 2) triazoles e.g. myclobutanil (Systhane 20 EW), paclobutrazol (Bonzi, Pirouette) and propiconazole (Bumper 250 EC); and 3) a group which prevents gibberellin production late in its biosynthesis: prohexadione calcium (Regalis), trinexapac-ethyl (Cutaway, Moddus and Primo Maxx II) and daminozide (B-nine). The

exception is ethephon (a component of Terpal) which breaks down within the plant to produce the plant hormone, ethylene. Of the three groups the triazoles are the most active, although levels of activity varies within this group.

A range of plant growth regulators was trialled on four bedding plant species (*Begonia semperflorens* 'Heaven' mixed, seed; *Dianthus* 'Festival' mixed, seed; Geranium 'Horizon' mixed, seed; Pansy 'Matrix' mixed, seed and two pot plant species (New Guinea *Impatiens* 'Divine Cherry Red', seed; and *Zantedeschia*, twelve varieties – 'Captain Series', 18-20mm corms). The bedding plants and New Guinea *Impatiens* were transplanted in weeks 21 (23 May 2017) and 22 (31 May 2017) respectively at Baginton Nurseries. The *Zantedeschia* were planted in week 18 (02 May 2017) by Lovania Nurseries (Preston, Lancs) and transported to Baginton Nurseries in week 20 (17 May 2017). The bedding and pot plants (New Guinea *Impatiens* and *Zantedeschia*) were transplanted into six-packs and 1L pots respectively.

Products tested are listed in **Table 1**. Sprays were applied by hand using a backpack and single nozzle lance, with an 02f110 nozzle, to achieve a fine spray quality, in a water volume of 300L/ha. All treatments were applied during late afternoon/early evening with shade screens over the crop prior to treatment.

For the New Guinea *Impatiens* and *Zantedeschia* in 1L pots, 75ml was applied as the drench, followed by 25ml as plain water to wash plant growth regulators off the foliage and into the growing media. For the six-pack bedding, 101.25ml was applied to each pack as the drench, followed by 33.75ml of plain water.

Treatments were applied as a foliar spray or drench from one week post-transplant, except for the *Zantedeschia*, where drench treatments were applied from two weeks after planting, when the new shoots were 1-2cm tall; spray treatments were applied from four weeks after planting.

The number of applications varied depending upon plant species and PGR product. All the bedding plant varieties and New Guinea *Impatiens* received two spray or drench applications (with the exception of Moddus and Regalis Plus, which were applied once only), the *Zantedeschia* received two spray or three drench treatments (Moddus and Regalis Plus were applied only once as sprays and Moddus once as a drench, but two Regalis Plus drenches were applied as they were made three weeks apart).

Table 1. Approval status of PGR products and treatments applied - 2017

	Product	Active ingredient	Application method	Dose rate	Approval status
1	HDC P005		Spray*	2.25ml/L (0.675L/ha)	Not approved on protected ornamentals in UK
2			Drench*		
3	Terpal (MAPP 16463) + Activator 90 (ADJ 0547)	Ethephon + mepiquat chloride	Spray*	6.67ml/L (2.0L/ha) +40ml/100L spray solution	EAMU 0151/18 issued 30.01.18
4			Drench*		
5	Regalis Plus (MAPP 16485)	Prohexadione	Spray	4.17g/L (1.25kg/ha)	EAMU 0181/15. Three weeks must be allowed between applications
6			Drench*		
7	Dazide Enhance (MAPP 16092)	Daminozide	Spray	6.0g/L (1.8kg/ha)	Full approval
8			Drench*		
9	Primo Maxx II (MAPP 17509)	Trinexapac-ethyl	Spray*	6.67ml/L (2.0L/ha)	Not approved on protected ornamentals in UK (EAMU issued after the trial)
10			Drench*		

11	Moddus (MAPP 15151)	Trinexapac-ethyl	Spray	2ml/L (0.6L/ha)	EAMU 3062/10. One application only permitted per crop
12			Drench*		
13	Untreated	-	-	-	-

* Treatments applied under experimental permit.

Plant height and growth

The treatment effects on plant height and growth varied between plant species and application method. Spray treatments were generally less effective than drench treatments in controlling plant height.

Spray applications

Terpal + Activator 90 showed most promise out of the new products, controlling growth of all plant species compared with the untreated control. Dazide Enhance sprays provided some growth control of *Begonia* and Pansy under the conditions of this trial, 20 days after treatment (DAT). The remaining products all controlled the growth of some species to varying degrees. Moddus did reduce growth of New Guinea *Impatiens* (41 DAT) with the single application permitted by the approval. Similarly, a single application of Regalis Plus was made as the approval requires three weeks between treatments, and this reduced growth of Pansy (20 DAT) and *Zantedeschia* (20 and 33 DAT).

Spray application of HDC P005 showed promise, controlling growth in the *Dianthus*, Pansy, New Guinea *Impatiens* and *Zantedeschia*, while Primo Maxx II controlled the growth of Geranium, New Guinea *Impatiens* and *Zantedeschia*.

Drench applications

Drench applications of HDC P005, Moddus, Primo Maxx II, Regalis Plus and Terpal + Activator 90 all had a strong effect at the rates used in this trial, controlling the height of all species to varying degrees. For some species the effect was too strong, resulting in plants that were too small.

Flowering

None of the treatments had a significant effect on flowering of Geranium. Significantly fewer flowers were produced by the Pansy (20 DAT) due to the Terpal + Activator 90 spray and drench treatments compared with the untreated control, indicating delayed flowering. The New Guinea *Impatiens* was more sensitive than other species, producing significantly fewer flowers than the untreated control in the majority of treatments throughout the trial; the exceptions were the Dazide Enhance and Regalis Plus sprays.

Flowering was delayed by the Terpal + Activator 90 drench treatments, with significantly fewer flowers produced compared with the untreated control on the *Begonia*, *Dianthus*, and Pansy at 20 DAT, and on the New Guinea *Impatiens* at all assessments; no flowers were produced in the Geranium or New Guinea *Impatiens*. Within the timescale of this trial, the *Zantedeschia* did not produce any flowers in the untreated control, and few flowers in the treatments.

Phytotoxicity

Spray treatments

Minimal or no phytotoxicity was recorded in the Dazide Enhance and HDC P005 spray treatments on all plant species. Similarly little phytotoxicity was recorded for the Moddus spray treatments, with the exception of treatments on *Dianthus*, which showed significant phytotoxicity 10 DAT; this was not evident by 20 DAT.

Strong phytotoxicity was recorded in treatments of Primo Maxx II and Terpal + Activator 90 treatment on *Dianthus* (10 DAT); and slight phytotoxicity found on *Dianthus* and Pansy (20 DAT). Primo Maxx II also caused slight phytotoxicity on *Begonia* (20 DAT).

Drench treatments

The Dazide Enhance did not cause significant phytotoxicity, with the exception of some leaf yellowing present in Pansy, 10 DAT, but these symptoms were no longer evident by 20 DAT. None of the drench treatments caused phytotoxicity symptoms on *Zantedeschia*.

Regarding the HDC P005 drench, no phytotoxicity symptoms were apparent 10 DAT, but were present by 20 DAT in all the bedding species and New Guinea *Impatiens*; no phytotoxicity was present on the *Zantedeschia*.

In the case of the Moddus drench, phytotoxicity symptoms appeared by 10 DAT in Pansy and New Guinea *Impatiens*, and by 20 DAT in *Begonia*, Geranium, Pansy and New Guinea *Impatiens*. No phytotoxicity was present in the *Zantedeschia*.

Regalis Plus caused phytotoxicity in the *Begonia*, Geranium and New Guinea *Impatiens* by 20 DAT.

The Terpal + Activator 90 drench treatment was too strong, resulting in phytotoxicity to all plant species with the exception of *Zantedeschia*.

Summary of results by plant species

- *Begonia semperflorens* 'Heaven'
 - Spray treatments generally did not effectively control growth; the exception was the Terpal spray which had a strong effect.
 - Drench treatments were generally too strong, producing plants that were too small, except for Dazide Enhance which had a slight effect on plant growth.
 - Phytotoxicity ranged from slight (HDC P005, Dazide Enhance, Moddus and Primo Maxx II) to severe (Regalis Plus and Terpal + Activator 90).
 - Flowering time was significantly delayed by the drench treatments (HDC P005, Moddus, Primo Maxx II, Regalis Plus and Terpal + Activator 90) at the final assessment. Spray treatments did not delay flowering.
- *Dianthus* 'Festival'
 - Spray treatments of HDC P005 were effective on *Dianthus* growth compared with the untreated control, but Dazide Enhance, Moddus, Primo Maxx II, and Regalis Plus were not effective. Terpal + Activator 90 had a slight effect.
 - Drench treatments of HDC P005, Moddus, Primo Maxx II and Terpal + Activator 90 all had a strong effect. Dazide Enhance and Regalis Plus (single application) were ineffective and had a slight effect respectively.
 - Slight phytotoxicity was caused by the Terpal + Activator 90 drench treatment.
 - Significantly fewer flowers were produced in the HDC P005 and Terpal + Activator 90 drench treatments at the final assessment.
- Geranium 'Horizon'
 - Spray applications of Primo Maxx II and Terpal + Activator 90 were effective in controlling growth, HDC P005, Dazide Enhance, Moddus and Regalis Plus did not control growth.
 - Terpal + Activator 90 treatment caused slight chlorosis at the rate used when applied as a spray.
 - Drench treatments of HDC P005, Moddus, Primo Maxx II, Regalis Plus and Terpal + Activator 90 were too strong at the rates used, controlling growth but also causing slight to severe phytotoxicity.

- Pansy 'Matrix'
 - The Pansy in all treatments including the untreated control were below 80mm in height.
 - Spray treatments of HDC P005, Dazide Enhance, Regalis Plus and Terpal + Activator 90 were all effective in controlling growth compared with the untreated control; Moddus and Primo Maxx II were not effective.
 - Drench treatments of HDC P005, Moddus and Regalis Plus were effective on Pansy with no or minimal phytotoxicity. Dazide Enhance was not effective. Primo Maxx II and Terpal + Activator 90 were too strong and caused severe phytotoxicity.
 - Fewer flowers were produced in both the spray and drench treatments of Terpal + Activator 90; no other treatments affected flowering.

- New Guinea *Impatiens* Divine 'Cherry Red'
 - All products except for Regalis Plus (single spray) reduced plant growth when applied as sprays.
 - Drench treatments were all too strong and with varying degrees of phytotoxicity ranging from slight (HDC P005, Dazide Enhance and Moddus) to severe (Primo Maxx II, Regalis Plus and Terpal + Activator 90).
 - Fewer flowers were produced in the spray and drench treatments of HDC P005 and Terpal + Activator 90; and drench treatments of Moddus, Primo Maxx II and Regalis Plus.

- *Zantedeschia* 'Captain' Series
 - No phytotoxicity was observed in either spray or drench treatments.
 - Spray treatments of Terpal + Activator 90 effectively controlled plant growth; HDC P005 and Regalis Plus had some effect on plant growth; other products had no effect.
 - Drench treatment of Terpal + Activator 90 had the strongest effect on plant growth; all other treatments had a slight effect except for Dazide Enhance which had no effect.
 - Few flowers were produced on the *Zantedeschia* within the timeframe of this trial.

Terpal + Activator 90 was perhaps the most promising product of those tested, controlling growth of all subjects when applied both as a spray and drench. However, the drench rate used was too strong, producing plants that were too small, delaying flowering and causing phytotoxicity. The spray treatment delayed flowering in New Guinea *Impatiens* and Pansy but not the other species.

Growers find it particularly difficult to control the growth of *Dianthus*, therefore it was promising that HDC P005 had an effect in this trial.

While spray applications of Moddus and Regalis Plus did not control growth as effectively as some other products, only one application was made to all species. No phytotoxicity was recorded by either of these treatments at the final assessment, therefore these products may prove useful as part of a spray programme, particularly for plant species with a longer production time.

While the drench treatments of most of the products tended to be too strong, this does provide the opportunity to test lower application rates to achieve good growth control without phytotoxicity and delayed flowering.

Financial benefits

The evaluation of plant growth regulators (PGRs) either approved in the UK or in other European Countries for use on bedding plants (spray and drench application), followed by appropriate AHDB EAMU applications will expand the range of active ingredients in the growers' armoury for controlling plant growth. Whilst growers do use cultural methods (e.g. temperature, diff/drop, controlling irrigation and nutrient supply) to control plant growth where possible, lack of cost-effective PGRs approved for use on protected ornamentals would reduce the range of plants that can be produced profitably within client specifications. PGRs are particularly important when used to hold mature crops at a specified height during periods of low demand where other methods would lead to unacceptable effects e.g. leaf yellowing. The cost per litre of spray solution to apply the products included in this trial at the specified rates ranges from 0.5p to 88.4p (**Table 2**) and provides greater opportunity to increase profit through reduced input cost.

Table 2. PGR costs (non-discounted, excluding VAT and labour costs for application)

Product	Cost of active ingredient (p/ml)	Cost of spray at rate used** (p/L)
Bonzi	9.5	11.9
Dazide Enhance	14.7	88.4
HDC P005	XX	XX
Moddus	3.9	7.8
Primo Maxx II	5.0	33.3
Regalis Plus	12.3	51.3
Terpal + Activator 90	2.4	11.6
Terpal*	1.7	11.3
Activator 90*	0.6	0.3

*Individual cost of adjuvant and PGR. Regalis Plus and Moddus applied as a single treatment; all other products applied as two treatments due to label requirements. **Refers to full approval/EAMU rate.

Action points

- Test new or unfamiliar products on a small number of plants before large scale use.
- Growers should familiarise themselves with and adhere to product labels, approvals and Extensions of Approval for Minor Use (EAMUs) prior to use. Note that a number of the treatments included in this trial have been carried out under experimental permit and are not currently authorised for nursery use in the UK.
- Growers should note that that the spray rate used in the trials (300 litres per hectare) may be lower than the rate they currently use and as such application rates or volumes may need to be adjusted to maintain the same application rate of active ingredient.
- Of the products currently with approved uses on protected ornamentals in the UK, useful effects were achieved with spray treatments of Terpal + Activator 90 on Geranium 'Horizon',

Pansy 'Matrix' and New Guinea *Impatiens*; Regalis Plus on Pansy 'Matrix'; and Moddus on New Guinea *Impatiens*.

- Although their use is not currently permitted on protected ornamentals, useful effects were achieved with spray treatments of HDC P005 on *Dianthus* 'Festival', Pansy 'Matrix' and New Guinea *Impatiens*; Primo Maxx II on Geranium 'Horizon' and New Guinea *Impatiens*. EAMU applications have been submitted for Primo Maxx II and HDC P005.
- Useful effects were achieved with drench treatments of Terpal + Activator 90 on Pansy 'Matrix' and *Zantedeschia*; Moddus on Pansy 'Matrix'; and Regalis Plus on Pansy 'Matrix'.