



# Grower Summary

**PO 019b**

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 plants pre- and post-transplant

Annual Report

**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 plants pre- and post-transplant*

**Project number:** PO 019b

**Project leader:** Dr Jill England, ADAS Boxworth

**Report:** Annual report, 30 April 2020

**Previous report:** None

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**Location of project:** Baginton Nurseries, Coventry, Warwickshire

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**Date project commenced:** 1 April 2019

**Date project completed** 30 April 2020

**(or expected completion date):**

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## AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Date 30 April 2020

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Date 30 April 2020

## Grower Summary

### Headline

- Effective pre- and post-transplant plant growth regulator spray programmes were identified for *Cosmos* 'Sonata' carmine, *Dianthus* 'Festival' violet, Geranium 'Horizon' red and *Osteospermum* 'Akila' purple.
- Primo Maxx II (trinexapac-ethyl) is not recommended for use on Cosmos. Moddus (trinexapac-ethyl) is not recommended for use on Geranium.

### 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 are also included in the programme.

The work programme is guided by a grower-led Management Group that includes members of the British Protected Ornamental Association (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 plants pre- and post-transplant*

### 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 label restrictions and loss of approval for the use of chlormequat based products in protected ornamental plant production. Growers apply PGRs as drenches, sometimes during propagation, and have developed application rates specific to the crops they grow under the specific growing conditions on their nurseries. This trial re-examines PGRs previously tested at the BPPC as spray programmes for use from plug stage to marketing.

A range of plant growth regulators with or without the adjuvant (Stena) was trialled on four seed-raised bedding plant species (*Cosmos* 'Sonata' carmine, *Dianthus* 'Festival' violet, Geranium 'Horizon' red and *Osteospermum* 'Akila' purple). All species were treated with PGRs in the plug tray two days prior to transplant using either a spray, sprench (5% of plug tray volume) or drench (10% of plug tray volume) at a water rate of 300 L/ha. Plants were then

transplanted in week 21 (*Dianthus* and Geranium), week 29 (*Cosmos*) and week 31 (*Osteospermum*) at Baginton Nurseries, using standard 6-packs for the *Dianthus* and Geranium, and jumbo 6-packs for the *Cosmos* and *Osteospermum*.

Products tested are listed in **Table 1**. Sprays (pre- and post-transplant) 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 300 L/ha (note this may be lower than the rate currently used by growers). Pre-transplant sprenches (5% of plug tray volume) were applied using a hand-held mister and pre-transplant drenches (10% of plug tray volume) were applied using a syringe. Post-transplant sprenches (5% of pack volume) were applied by hand using a backpack and single nozzle lance, with a 02f110 nozzle. All treatments were applied during early morning or late afternoon with shade screens over the crop prior to treatment. Treatments were applied as a foliar spray or sprench at one week post-transplant, and then after a further 10 days minimum if deemed necessary, up to a maximum of two applications post-transplant. An overspray of Bonzi (2.0 ml/L) was applied on 21 August 2019 to prevent plants from becoming stretched before flowering.

**Table 1.** Approval status of PGR products tested in 2019

<b>Product</b>	<b>Active ingredient</b>	<b>Approval status</b>
Bonzi	paclobutrazol	On-label approval
Canopy (MAPP 16314)*	mepiquat (as chloride) and prohexadione calcium	EAMU 4484/19
Dazide Enhance (MAPP 16092)	daminozide	On-label approval
Moddus (MAPP 15151)	trinexapac-ethyl	EAMU 3062/10
Pirouette (MAPP 17203)	paclobutrazol	On-label approval (spray application) and EAMU 1269/17 (drench application)
Primo Maxx II (MAPP 17509)	trinexapac-ethyl	EAMU 0621/18
Regalis Plus (MAPP 16485)	prohexadione	EAMU 2153/19
Stena (ADJ 0895)+	polyglycerol	Adjuvant
Terpal (MAPP 16463)	ethephon + mepiquat chloride	EAMU 0151/18

\*Canopy applied under experimental permit in 2019 and coded as HDC P005 in previous reports. Note that rates used in the trial may be higher than permitted in EAMU 4484/19 (issued 18 December 2019).  
 +Stena applied under experimental permit in 2019 and coded as HDC P006; authorisation issued October 2019.

A number of PGRs, either alone or in combination provided effective growth control on the species included in this trial, when applied pre- and post-transplant, although some treatments

also caused paling of the foliage / flowers. All of the products tested, except for Primo Maxx II, featured in spray programmes that had a significant effect on plant growth compared with the water only control without adversely affecting plant quality.

### **Cosmos 'Sonata' carmine**

The *Cosmos* trial received two post-transplant PGR applications. A number of PGR programmes proved effective, producing plants within or close to a height specification of 15-20 cm, and these are presented in **Table 2**.

Most effective treatments. The most effective treatments were T4 (Pirouette plug srench, two sprays of Dazide Enhance), T5 (Pirouette plug srench, two sprays of Canopy), T8 (Pirouette plug srench, one spray of Regalis Plus, one spray of Pirouette) and T9 (Pirouette plug srench, two sprays of Terpal) compared with the water only control.

Also effective. Treatments T6 (Pirouette plug srench, one spray of Terpal, one spray of Pirouette). Treatment T3 (Pirouette plug, one spray of Pirouette, one spray of Pirouette) did control plant growth compared with the water control, but plants were marginally outside the height specification at 20.5 cm. These treatments would achieve greater height control with a slight adjustment to treatment rates.

Not effective. Treatment T2 (Pirouette plug srench, 0.6 L/ha; two sprays of Pirouette, 0.75 L/ha) was not effective on *Cosmos*.

Flowering. None of the treatments significantly delayed flowering.

Phytotoxicity. Primo Maxx II is not recommended for use on *Cosmos* as it caused slight petal bleach when applied at 2.0 L/ha (**Figure 4**).



**Figure 1.** *Cosmos* with slight petal bleaching seen in plants treated with T7 Pirouette and Primo Maxx II (right) compared to the water control (left), week 41 2019

**Table 2.** *Cosmos 'Sonata' carmine* - effective PGR programmes

Trt.	Pre-transplant Sprech <sup>+</sup>		Post-transplant 1 Spray <sup>++</sup>		Post-transplant 2 Spray <sup>++</sup>	
	Product	Dose	Product	Dose	Product	Dose
T3	Pirouette	2.0 ml/L (0.6 L/ha)	Pirouette	4.0 ml/L (1.2 L/ha)	Pirouette	5.0 ml/L (1.5 L/ha)
T4			Dazide Enhance	6.0 g/L (1.8 kg/ha)	Dazide Enhance	6.0 g/L (1.8 kg/ha)
T5			Canopy*	2.25 g/L (0.675 kg/ha)	Canopy*	2.25 g/L (0.675 kg/ha)
T6			Terpal	6.67 ml/L (2.0 L/ha)	Pirouette	3.0 ml/L (0.9 L/ha)
T8			Regalis Plus	4.17 g/L (1.25 kg/ha)	Pirouette	2.0 ml/L (0.6 L/ha)
T9			Terpal	6.67 ml/L (2.0 L/ha)	Terpal	6.67 ml/L (2.0 L/ha)

\*Treatments applied under experimental permit. Canopy applied under experimental permit in 2019 and coded as HDC P005 in previous reports. Note that rates used in the trial may be higher than permitted in EAMU 4484/19 (issued 18 December 2019). +Sprech applied at 5% of the plug tray volume, using a water rate of 300 L/ha. ++Foliar sprays applied in 300 L water/ha.

### ***Dianthus* 'Festival' violet**

The *Dianthus* trial received two post-transplant PGR applications. A number of PGR programmes proved effective, producing plants within or close to a height specification of 8-10 cm and these are presented in **Table 3**.

Most effective treatments. Treatment T2 (Pirouette plug spray, two sprays of Pirouette) was the most effective on *Dianthus*.

Also effective. Plants in treatments T3 (Pirouette plug drench, two sprays of Pirouette) and T4 (Terpal plug drench, two sprays of Terpal) were effective, but just outside of specification, with heights of 7.8 cm and 10.4 cm respectively. These treatments would achieve greater height control with a slight adjustment to application rates.

Not effective. Treatment T5, a Terpal plug drench (0.5 L/ha) followed by one spray of Terpal + Stena (0.5 L/ha + 0.75 L/ha) was not effective on *Dianthus*.

Flowering. Treatment T3 (Pirouette plug drench, two sprays of Pirouette) produced the fewest plants in flower, recorded at 83% by the end of the trial.

Phytotoxicity. There was no evidence of phytotoxicity as a result of any of the treatments.



**Table 3.** *Dianthus* 'Festival' violet - effective PGR programmes

Trt.	Plug treatment Spray (S) <sup>+</sup> / Drench (D) <sup>++</sup>		Post-transplant 1 Spray <sup>+</sup>		Post-transplant 2 Spray <sup>+</sup>	
	Product	Rate	Product	Rate	Product	Rate
T2	Pirouette (S)	1.5 ml/L (0.45 L/ha)	Pirouette	1.5 ml/L (0.45 L/ha)	Pirouette	1.5 ml/L (0.45 L/ha)
T3	Pirouette (D)	1.0 ml/L (0.3 L/ha)	Pirouette	1.5 ml/L (0.45 L/ha)	Pirouette	1.5 ml/L (0.45 L/ha)
T4	Terpal (D)	3.33 ml/L (1.0 L/ha)	Terpal	3.33 ml/L (1.0 L/ha)	Terpal	3.33 ml/L (1.0 L/ha)

+Foliar sprays applied in 300 L water/ha. ++Drenches applied by hand with a syringe at 10% of the plug tray volume, using a water rate of 300 L/ha.

### Geranium 'Horizon' red

The Geranium trial received one PGR post-transplant application. A number of the PGR programmes tested were effective, producing plants within the height specification of 8 -10 cm (**Table 4**).

Most effective treatments. The most effective treatments without impact on plant quality were T3 (Terpal plug drench, one spray of Terpal + Stena), T4 (Terpal plug drench, one spray of Terpal) and T6 (Pirouette plug drench, one spray of Terpal).

Not effective. Treatment T2 (Terpal plug spray 0.225 L/ha, one spray of Terpal 0.5 /ha + Stena 0.75 L/ha) was not effective.

Flowering. Flowering was poor in the water only control, with only 2.8% of plants in flower by 65 days after treatments. There were no flowers produced in treatments T3, T4 and T5, but treatment T6 (Pirouette plug drench 0.3 L/ha, one spray of Terpal 0.75 L/ha) promoted flowering (12.5%) compared with the water control.

Phytotoxicity. Treatments T3 (Terpal plug drench 0.5 L/ha, one spray of Terpal + Stena 0.5 L/ha + 0.75 L/ha) and T4 (Terpal plug drench 0.45 L/ha, one spray of Terpal 0.75 L/ha) caused some leaf chlorosis early on in the trial, but the plants grew away from this. The foliage and flowers in T5 (Moddus plug drench 0.15 L/ha, one spray of Terpal + Stena 0.5 L/ha + 0.75 L/ha) were pale and the zoning was less pronounced than in other treatments, therefore this treatment is not recommended on Geranium (**Figure 7**).



**Figure 2.** Plants treated with T5 (Moddus plug drench and one spray of Terpal + Stena), showing paler foliage and zoning, and slightly pale flowers (right) compared to the water control (left), week 32 2019

**Table 4.** Geranium 'Horizon' red - effective PGR programmes

Trt No.	Plug treatment Spray (S) <sup>+</sup> / Drench (D) <sup>++</sup>		Post-transplant 1 Spray <sup>+</sup>	
	Product	Rate	Product	Rate
T3	Terpal (D)	1.67 ml/L (0.5 L/ha)	Terpal + Stena *	1.67 ml/L (0.5 L/ha) + 2.5 ml/L (0.75 L/ha)
T4	Terpal (D)	1.5 ml/L (0.45 L/ha)	Terpal	2.5 ml/L (0.75 L/ha)
T6	Pirouette (D)	1.0 ml/L (0.3 L/ha)	Terpal	2.5 ml/L (0.75 L/ha)

\*Treatments applied *under experimental permit*. Stena applied under experimental permit in 2019 and coded as HDC P006 in previous reports. ADJ 0895 (issued 30 October 2019). +Foliar sprays applied in 300 L water/ha. ++Drenches applied by hand with a syringe at 10% of the plug tray volume, using a water rate of 300 L/ha.

### ***Osteospermum* 'Akila' purple**

The *Osteospermum* trial received two post-transplant PGR applications, with plants in a number of treatments achieving the height specification of 8 -10 cm (**Table 5**). Plant quality may have been impacted by the timing of this trial, under decreasing temperatures and shortening day length, therefore the results should be treated with caution.

Effective treatments. Treatments T2 (Regalis Plus plug spray, one srench of Canopy + Stena, one srench of Regalis Plus), T3 (Terpal plug drench, one srench of Regalis Plus, one srench of Canopy), and T5 (Terpal plug drench, two srenches of Terpal + Stena) were the most effective, producing plants of marketable quality and within the height specification.

The dose rate used in treatment T4 (Terpal plug drench 2.0 L/ha, two srenches of Terpal 2.0 L/ha) proved too high, and impacted on plant quality (score 2.0), plant height (average 4.8 cm) and plants did not flower. With an adjustment to the dose rate, this may prove a useful spray programme.

Not effective. Treatments T6 (Pirouette plug drench, one srench of Pirouette) and T7 (Pirouette plug drench; one srench of Pirouette) were not effective.

Flowering. Flowers were produced in the water only control and treatments T6 and T7. All other treatments produced buds, but did not flower within the trial period.

Phytotoxicity. After one post-transplant sprench, T7 (Pirouette plug drench, one sprench of Pirouette) showed some yellow leaf spotting, but the plants grew away from this. There was no evidence of chlorosis, bleaching or distortion at the end of the trial.

**Table 5.** *Osteospermum* 'Akila' purple - effective PGR programmes

Trt.	Plug treatment Spray (S) <sup>+</sup> / Drench (D) <sup>++</sup>		Post-transplant 1 Sprenc <sup>+++</sup>		Post-transplant 2 Sprenc <sup>+++</sup>	
	Product	Rate	Product	Rate	Product	Rate
T2	Regalis Plus (S)	4.17 g/L (1.25 kg/ha)	Canopy + Stena *	1.12 g/L (0.337 kg/ha) + 2.5 ml/L (0.75 L/ha)	Regalis Plus	4.17 g/L (1.25 kg/ha)
T3	Terpal (D)	1.67 ml/L (0.5 L/ha)	Regalis Plus	4.17 g/L (1.25 kg/ha)	Canopy*	2.25 g/L (0.675 kg/ha)
T5	Terpal (D)	3.33 ml/L (1.0 L/ha)	Terpal + Stena *	3.33 ml/L (1.0 L/ha) + 2.5 ml/L (0.75 L/ha)	Terpal + Stena *	3.33 ml/L (1.0 L/ha) + 2.5 ml/L (0.75 L/ha)

\*Treatments applied under experimental permit. **Stena** applied under experimental permit in 2019 and coded as HDC P006 in previous reports. ADJ 0895 (issued 30 October 2019). **Canopy** applied under experimental permit in 2019 and coded as HDC P005 in previous reports. Note that rates used in the trial may be higher than permitted in EAMU 4484/19 (issued 18 December 2019). +Foliar sprays applied in 300 L water/ha. ++Drenches applied by hand with a syringe at 10% of the plug tray volume, using a water rate of 300 L/ha. +++Sprenc<sup>+++</sup> applied at 5% of the pack volume, using a water rate of 300 L/ha.

## Financial benefits

The evaluation of PGRs either approved in the UK or in other European Countries for use on bedding plants, followed by appropriate AHDB EAMU applications, will expand the range of active ingredients available to growers' for controlling plant growth. Whilst growers do use a range of cultural methods (e.g. reductions in growing temperatures, deficit irrigation and minimising the nutrient supply) to control plant growth where possible, lack of cost-effective PGRs, approved for use on protected ornamentals, would likely reduce the range of plants that can be produced profitably within client specifications.

PGR applications are required from germination onwards for many plant species to keep growth in check, and a lack of control at any point can lead to downgrading or losses quite quickly, or the need to undertake expensive cultural corrective measures, such as pinching or trimming.

PGRs are also important when used to hold mature crops at the specified height during any period of low demand, where other physical methods may lead to unacceptable impacts on quality such as leaf yellowing or flower bud drop.

The cost per litre of spray solution of each treatment (excluding application) included in this trial at the specified rates, ranged from 2p to 88.2p (**Table 6**). All (including the other 'standard' products) are more expensive than the chlormequat based product, Stabilan 750, as chlormequat based products are primarily used on cereal crops to control growth and prevent stem lodging, and therefore there is a much larger market for their use. However, all the products examined still provide greater opportunity to increase business profit through reduced input cost.

The use of the adjuvant Stena could be used to reduce the cost per litre of some of the treatments further, if its addition permits a reduction in the rate used while generating the same effect. For some of the less expensive PGR products however, the use of the adjuvant would provide no financial saving due to its relative cost.

**Table 6.** PGR costs (non-discounted, excluding VAT and labour costs for application)

Product and rate	Cost of active (p)	Cost/L of spray (p)
Bonzi (2.0 ml/L)	9.5/ml	19
Canopy (1.12 g/L)	2.2/g	2.5
Dazide Enhance (6.0 g/L)	14.7/g	88.2
Moddus (0.5 ml/L)	3.9/ml	2.0
Pirouette (1.0 ml/L)	9.5/ml	9.5
Primo Maxx II (6.67 ml/L)	5.0/ml	33.4
Regalis Plus (4.17 g/L)	12.3/g	51.3
Terpal (2.5 ml/L )	1.8/ml	4.3
Stena, adjuvant (2.5 ml/L)	2.0/ml	5.0

## Action points

Effective spray programmes were identified for all four species and growers may wish to trial these further on small batches of plants to identify suitable commercial treatments:

- **Cosmos 'Sonata' carmine.** Pirouette as a pre-transplant sprinch (2.0 ml/L) applied at 5% of plug volume), followed by applications of Pirouette, Dazide Enhance, Canopy, Terpal, or Regalis Plus. Refer to **Table 2** for PGR programmes.
- **Dianthus 'Festival' violet.** Pirouette treatments (pre- and post-transplant) were effective on Dianthus. A PGR programme using Terpal (also pre- and post-transplant) produced plants slightly outside the height specification, but would be more effective with an adjustment to dose rates. Refer to **Table 3** for PGR programmes.

- **Geranium ‘Horizon’ red.** Effective PGR programmes included pre-transplant drenches of Terpal or Pirouette, followed by Terpal with or without Stena. Refer to **Table 4** for PGR programmes.
- **Osteospermum ‘Akila’ purple.** Useful PGR programmes included a pre-transplant Regalis Plus spray or a Terpal drench, followed by application of Canopy, Regalis Plus or Terpal + Stena. Refer to **Table 5** for PGR programmes.
- Growers should note that that the spray rate used in these 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.
- Growers should familiarise themselves with and adhere to product labels, approvals and Extensions of Approval for Minor Use (EAMUs) prior to use. PGRs applied under EAMU authorisation are made at the grower’s own risk. (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).