



Grower Summary

PO 019b

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

***Objective 2. To evaluate plant growth regulators for use on
bedding plant plugs at cotyledon stage (drench application)***

Annual Report

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

Objective 2. *To evaluate plant growth regulators for use on bedding plant plugs at cotyledon stage (drench application)*

Project number: PO 019b

Project leader: Dr Jill England, ADAS Boxworth

Report: Annual report, 31 March 2020

Previous report: None

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Chloe Whiteside (ADAS), Horticulture Consultant
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Location of project: Baginton Nurseries, Coventry, Warwickshire

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Date project commenced: 1 April 2019

Date project completed 31 March 2020

(or expected completion date):

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AUTHENTICATION

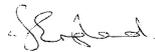
We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Dr Jill England

Senior Horticulture Consultant

ADAS

Signature



Date 30 April 2020

Chloe Whiteside

Horticulture Consultant

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Signature



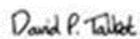
Date 30 April 2020

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Date 30 April 2020

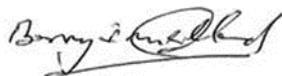
Report authorised by:

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Date 30 April 2020

Grower Summary

Headline

- Effective plant growth regulator (PGR) treatments for application at the cotyledon stage, with no follow-up PGR application required, were identified for *Cosmos* 'Sonata' carmine, *Dianthus* 'Festival' violet and French Marigold 'Durango' red.
- Primo Maxx II (trinexapac-ethyl, applied at 0.5 L/ha) on *Cosmos* 'Sonata' carmine, and Terpal (ethephon + mepiquat chloride, applied at 1.0 L/ha) on *Dianthus* 'Festival' violet are not recommended due to petal bleach or spotting with limited growth control.

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 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 2. *To evaluate plant growth regulators for use on bedding plant plugs at cotyledon stage (drench application).*

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 restrictions or loss of approval for the use of chlormequat in protected ornamental plant production.

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 specified height during periods of low demand where other methods could lead to unmarketable plants.

Many growers apply PGRs as 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.

This particular piece of work was prompted by trials work carried out at the Bedding and Pot Plant Centre in 2018, whereby PGR drenches were applied to a range of bedding species at the plug stage, two days prior to transplant. Low rates of the PGRs tested gave adequate growth control, with minimal or no phytotoxicity. A number of promising treatments and rates emerged from this trial, which prompted interest in treating plants in plug trays earlier, just after germination, to improve growth control in *Dianthus* and more vigorous species (*Cosmos* and Marigold), while minimising the risk of phytotoxicity.

In the 2019 trial, a range of plant growth regulators were trialled on three seed-raised bedding plant species (*Cosmos* 'Sonata' carmine, *Dianthus* 'Festival' violet and French Marigold 'Durango' red). Seed was sown into 240-cell trays in week 18 (02 May 2019) at ADAS Boxworth, and PGR treatments were applied to the plug trays once the seedlings had germinated and were at cotyledon stage. Treatments were applied as a drench at a rate of 10% of the tray volume, using the products at a concentration calculated to provide the same quantity of product as if treatments had been applied as a spray at 300 L/ hectare. Plugs were then transferred to Baginton Nurseries and transplanted in week 22 (*Cosmos* and French Marigold) and week 23 (*Dianthus*), using standard 6-packs for the *Dianthus* and French Marigold, and jumbo 6-packs for the *Cosmos*.

Products tested are listed in **Table 1**. Due to the relatively small plug cell size, and the number of plugs per treatment (72), plug plants were grouped into treatments within the plug tray and each PGR drench treatment was applied with a syringe over the plants, to ensure the correct amount of active ingredient was applied to each plug plant. All species were sown into 240-cell trays, with a cell volume of 12 cm³, meaning a 10% drench would be 1.2 ml per cell, or 14.4 ml per row of 12 plants. Treatment solutions (1 L) were made up in plastic containers, one for each treatment. Treatments were applied to plants using a syringe, one for each treatment, treating one row at a time.

Table 1. Approval status of PGR products tested in 2019 (Unauthorised or off-label treatments applied under experimental permit)

Product	Active ingredient	Approval status
Dazide Enhance (MAPP 16092)	daminozide	On-label approval
Canopy* (MAPP 16314)	mepiquat (as chloride) and prohexadione calcium	EAMU 4484/19 for spray application. 2 applications permitted per year
Moddus (MAPP 15151)	trinexapac-ethyl	EAMU 3062/10 for spray application. 1 application only permitted per crop
Pirouette (MAPP 17203)	paclobutrazol	On-label approval for spray application. EAMU 1269/17 for drench application
Primo Maxx II (MAPP 17509)	trinexapac-ethyl	EAMU 0621/18 for spray application
Regalis Plus (MAPP 16485)	prohexadione	EAMU 2153/19 for spray application.
Terpal (MAPP 16463)	ethephon + mepiquat chloride	EAMU 0151/18 for drench application

*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).

Treatments applied in this trial were developed using the 2018 trial results as a guide. *Cosmos* and French Marigold were new to the species list, and as PGRs hadn't been applied at such an early stage before in previous BPPC work, the treatment list was kept the same for each species (**Table 2**).

Table 2. PGR product and treatment list 2019 – *Cosmos*, *Dianthus* and French Marigold

Trt No.	Product*	Active ingredient	Dose rate (L or Kg/ha)**	Dose rate (ml or g/L)
1	Water control	N/A	N/A	N/A
2	Dazide Enhance	daminozide	1.8 kg/ha	6.0 g/L (full rate)
3	Canopy*	mepiquat chloride + prohexadione-calcium	0.505 kg/ha	1.68 g/L (3/4 rate)
4	Moddus*	trinexapac-ethyl	0.15 L/ha	0.5 ml/L (1/4 rate)
5	Pirouette	paclobutrazol	0.6 L/ha	2.0 ml/L
6	Primo Maxx II*	trinexapac-ethyl	0.5 L/ha	1.67 ml/L (1/4 rate)

7	Regalis Plus ⁺	prohexadione	0.62 kg/ha	2.08 g/L (1/2 rate)
8	Terpal	ethephon + mepiquat chloride	1.0 L/ha	3.33 ml/L (1/2 rate)

*Drenches applied by hand with a syringe, at 10% of the tray volume. **Products used at a concentration calculated to provide the same quantity of product as if treatments had been applied as a spray at 300 L/ hectare. ⁺Treatments applied under experimental permit.

Of the products included in this trial, those containing chlormequat or mepiquat chloride (Terpal and Canopy) were expected to have a similar effect on plant growth as Stabilan 750; those containing prohexadione calcium (Regalis Plus, Canopy) or trinexapac-ethyl (Primo Maxx II and Moddus) were expected to have a similar effect to the more familiar daminozide products (e.g. B-nine, Dazide Enhance).

Summary of results by product

Dazide Enhance

Dazide Enhance was applied at 1.8 kg/ha (full rate) and gave mixed results across the three plant species. Height was not well controlled in the *Cosmos* or *Dianthus* trials and flowering was also delayed in the *Cosmos* trial. Growth was reasonably well controlled in the French Marigold trial. Dazide Enhance (1.8 kg/ha) can be considered as an early treatment at cotyledon stage for French Marigold, but would require a post-transplant follow-up treatment for *Cosmos* and *Dianthus*.

Canopy

Canopy was applied at 0.505 kg/ha (3/4 rate) and gave good results for *Cosmos* and French Marigold. Height was well controlled throughout the two trials and plants were within the target height specification, although there were fewer open flowers at the end of the *Cosmos* trial, and more in the French Marigold trial compared to the water control. Canopy was also effective in the *Dianthus* trial at this rate, with plants just below the height specification in week 26. Canopy (0.505 kg/ha) can be considered as an early treatment at cotyledon stage for all three species, and will produce plants within the desired height specification without the need for any follow-up PGR treatments.

Moddus

Moddus was applied at 0.15 L/ha (1/4 rate). Plant height was well controlled in the *Dianthus* and French Marigold trials, with plants within the target range, but the treatment was less effective in the *Cosmos* trial. There were no signs of phytotoxicity, although flowering was delayed in the *Cosmos* and *Dianthus* trials. Moddus (0.15 L/ha) is suitable for use on *Dianthus* and French Marigold as a drench at cotyledon stage. A higher rate would likely be needed for

Cosmos, although phytotoxic effects are unknown, and flowering would likely be delayed further.

Pirouette

Pirouette was applied at 0.6 L/ha. Height was well controlled for all three species, and there was no evidence of phytotoxicity or delays in flowering. Pirouette (0.6 L/ha) is suitable for use on *Cosmos*, *Dianthus* and French Marigold as a drench at cotyledon stage.

Primo Maxx II

Primo Maxx II was applied at 0.5 L/ha (1/4 rate). Height was reasonably well controlled in the *Cosmos* trial, with plants just above the height specification in week 26. However, for *Dianthus* and French Marigold, the treatment may have been too strong, with plants just below the height specification. There was bleaching to the flower petals and foliage in the *Cosmos* trial (**Figure 1**), but no evidence of phytotoxicity in the other species, although fewer flowers were produced in the *Dianthus* compared to the water control. Primo Maxx II (0.5 L/ha) could be considered for use on *Dianthus* and French Marigold as a drench at cotyledon stage. It is not recommended for use on *Cosmos* due to petal bleaching.

Regalis Plus

Regalis Plus was applied at 0.62 kg/ha (1/2 rate). Height was well controlled in the *Dianthus* and French Marigold trials, but plants in the *Cosmos* trial were above the target height specification. There was no evidence of phytotoxicity or delays in flowering for any of the species tested. Regalis Plus (0.62 kg/ha) would be suitable for use on *Dianthus* and French Marigold as a drench at cotyledon stage. A higher rate may be required for use on *Cosmos*.

Terpal

Terpal was applied at 1.0 L/ha (1/2 rate). Growth control was good in the French Marigold trials, although potentially this rate was too strong, with plants too compact. The treatment was not effective on *Cosmos* or *Dianthus*; plants were taller than the water control at the end of the *Dianthus* trial. There was no evidence of phytotoxicity in the *Cosmos* or French Marigold trials, however the *Dianthus* flowers had white spots on them (**Figure 2**), and the foliage was paler in this treatment. Terpal (1.0 L/ha) is not recommended for use on *Dianthus* as a drench at cotyledon stage due to phytotoxicity and poor growth control. It can be considered as a drench at cotyledon stage on *Cosmos* and French Marigold, although flowering is delayed, and a higher rate may be required for growth control in *Cosmos*. The effect of a higher rate on phytotoxicity and flowering is unknown. (Note: growth control without damage was achieved with Terpal on *Dianthus* in the pre/post transplanting trial, see work package one report).



Figure 1. Pale flowers seen in *Cosmos* plants treated with Primo Maxx II 0.5 L/ha (right) compared to the water control (left), week 28 2019.



Figure 2. White spots seen on flowers of *Dianthus* plants treated with Terpal 1.0 L/ha, week 28 2019

Although a number of treatments were effective in controlling growth at plug stage, either dose rates may need to be adjusted to achieve the appropriate height specification, or a follow-up application may be required post-transplant.

The growth control effect of a number of the treatments evaluated in this trial was sustained post-transplant. A second PGR application was not required to achieve height specifications in a number of treatments: Pirouette (0.6 L/ha) and Canopy (0.505 kg/ha) on *Cosmos*, French Marigold and *Dianthus*; Moddus (0.15 L/ha), Primo Maxx II (0.5 L/ha) and Regalis Plus (0.62 kg/ha) on *Dianthus* and French Marigold; Dazide Enhance (1.8 kg/ha) and Terpal (1.0 L/ha) on French Marigold. This is useful when product is sold in packs or small pots and avoiding further PGR applications is seen as a benefit, but for larger added value products where a greater bulk is required it could be an issue and add to production times.

All PGR treatments delayed flowering slightly with *Cosmos* and this should be borne in mind when scheduling.

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 available to growers for controlling plant growth.

The cost per litre of spray solution of the products included in this trial at the specified rates ranges from 2p to 88.2p (**Table 3**) providing greater opportunity to increase business profit through reduced input cost and wastage minimisation.

The ability to apply PGRs to young plants in the plug tray prior to transplant not only reduces the cost by reducing the amount of product needed, it also saves on labour costs as smaller areas of higher density plant material can be treated. Where the impact of the PGR continues post-transplanting, it provides added benefit in that further PGR products may not need to be needed, depending on the final product being grown.

Table 3. PGR costs (non-discounted, excluding VAT and labour costs for application)

Product and rate	Cost of active (p)	Cost / L of spray (p)
Bonzi	9.5/ml	11.9
Dazide Enhance (6.0 g/L)	14.7/g	88.2
Canopy (1.68 g/L)	2.2/g	3.7
Moddus (0.5 ml/L)	3.9/ml	2.0
Pirouette (2.0 ml/L)	9.5/ml	19.0
Primo Maxx II (1.67 ml/L)	5.0/ml	8.4
Regalis Plus (2.08 g/L)	12.3/g	25.6
Terpal (3.33 ml/L)	1.7/ml	5.7

Action points

- Of the products currently approved for use on protected ornamentals in the UK, useful effects were achieved with drench treatments of Dazide Enhance (1.8 kg/ha), Pirouette 0.6 L/ha and Terpal 1.0 L/ha (not *Dianthus*) and these should be examined in small scale trials for potential use, if not already used commercially, to establish appropriate rates of application. (Drench application is not currently approved for Canopy, Moddus, Primo Maxx II or Regalis Plus and EAMU authorisations will be sought for these via AHDB where appropriate).
- Growers should 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. Applications made under EAMU authorisations are at the grower's own risk).