



Agriculture & Horticulture  
DEVELOPMENT BOARD



# Grower Summary

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## PO 004

Assessment of a number of  
new plant growth regulator  
products to control growth on  
commercial crops of bedding  
plants

Final 2011

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## **Further information**

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HDC is a division of the Agriculture and Horticulture Development Board.

**Project Number:** PO 004

**Project Title:** Assessment of a number of new plant growth regulator products to control growth on commercial crops of bedding plants

**Project Leader:** Wayne Brough

**Contractor:** ADAS

**Industry Representative:** Mike Smith, WD Smith and Son

**Report:** Final Report

**Publication Date:** 17 August 2011

**Previous report/(s):** None

**Start Date:** 1 March 2010

**End Date:** 31 August 2010

**Project Cost:** £ 14,924

## Headline

- Regalis and Cerone have potential for growth control on bedding plant species.
- Care should be taken when applying Regalis to avoid flower petal bleach, earlier applications of the product may limit the degree of bleaching.
- Consider the potential impact of Bumper 250 EC on the growth of plants, and the phytotoxic damage it can cause, when integrating fungicides and growth regulators in a spray programme.

## Background and expected deliverables

Currently there are three main chemical plant growth regulator active ingredients used within the bedding plant sector – chlormequat, daminozide and paclobutrazol. In terms of efficacy, paclobutrazol is the most effective of the three active ingredients on the majority of plant species grown. However, there is a potential future complication in that some triazole pesticides (including paclobutrazol) could be classified as endocrine disruptors when the methodology is available to determine this, so its long term future is not yet totally secure.

There have been recent issues with products containing daminozide with regards to having a stipulated re-entry period which had potential to make their use impractical for some short term protected crops like bedding plants. Thankfully this has been resolved but this does underline the vulnerability of the products currently used in the commercial production of ornamental crops.

Prohexadione-calcium (Regalis) has potential as an alternative growth regulator, being in the same chemical group as daminozide; it already possesses a Specific Off-Label Approval (SOLA 2866/2008) for use on outdoor nursery stock (which expires 31 December 2011). Limited trials work has been undertaken by BASF on a number of bedding plant species. Trials have indicated that the product works well on some species, resulting in compact growth. However, the work also highlighted that the product impacts on anthocyanin formation in certain species, giving rise to a flower petal bleach. If the effects of Regalis on flower colour could be minimised then it could prove to be a useful alternative chemical plant growth regulator for use on

bedding plant subjects.

Trinexapac-ethyl is a growth regulator used to control stem height and lodging in cereals and is also related to prohexadione-calcium. The active ingredient is sold as Moddus by Syngenta. There has been limited work undertaken with this product on protected ornamental crops, but like Regalis it has the potential to be a useful alternative growth regulator product.

2-chloroethylphosphonic acid possesses a SOLA (2743/2010) for use in ornamental plant production (with extra specific crop information in the advisory information section of the SOLA). The product is sold as Cerone by Bayer CropScience Limited, although it was previously marketed as Ethrel C (by Hortichem, now Certis). Its primary label use on bedding plant crops was to increase side branching in geranium crops.

The overall commercial objective of the project was to trial Regalis, Cerone and Moddus against a standard chemical growth regulator products currently used within the industry (Bonzi) and an untreated control. Additionally, two triazole fungicides (propiconazole (Bumper 250 EC) and myclobutanil (Sythane 20 EW)) were included in the trial to examine the potential effects of these products on plant growth. The aim was to show that some triazole fungicides, when applied for disease control, need to be taken into consideration within any growth control plan to avoid excessive growth control.

## **Summary of the project and main conclusions**

In the first phase of this project, a review was undertaken of products with potential to expand the range currently available to UK growers for plant growth regulation. A summary of this review is detailed as Appendix 1 of the main project report. Chemicals deemed to have greatest promise were then evaluated in trials on a commercial nursery (W D Smith and Son, Battlesbridge, Essex). These trials were carried out between May and June 2010 on replicated blocks of plants separated from commercial crop but grown to the same management regime (other than the application of plant growth regulators).

Eleven different bedding plant species were evaluated including the cutting raised subjects: Dahlia 'Gallery – Renoir Pink', Fuchsia 'Mojo – Deep Cerise and Pastel Violet', Surfinia 'Classic Vanilla' and Verbena 'Tamari Trailing Blue'; and the seed raised subjects: Begonia semperflorens 'Big', Dianthus 'Select – Whitefire', Geranium 'Black Velvet – Scarlet', Impatiens 'Envoy - White', Marigold 'Dorango -Tangerine', Petunia multiflora 'Dreams Blue' and Salvia 'Mohave'.

The cutting material was purchased from specialist suppliers; and the remaining plants were raised from seed on site into a range of appropriate plug tray sizes. A peat / bark growing media with base fertiliser and controlled release fertiliser was used as the potting media at transplanting. All the species were transplanted into 1 litre pots and placed down on mobile benching covered with perforated film and capillary matting. The plants were watered overhead by hand throughout the trial and treated for pest / disease as required.

The table below summarises the treatments applied:

<b>Treatment</b>	<b>Product and application method</b>	<b>Rate</b>
A	Untreated control	
B	Bonzi x 2 sprays	1.25 ml / litre of water
C	Regalis x 1 spray	1.25 g / litre of water
D	Regalis x 2 sprays	1.25 g / litre of water
E	Regalis x 1 drench	1.25 g / litre of water
F	Cerone x 1 spray	1.0 ml / litre of water
G	Moddus x 2 sprays	0.4ml / litre of water
H	Bumper 250 EC x 2 sprays	0.4 ml /litre of water
I	Systhane 20 EW x 2 sprays	0.3 ml / litre of water

*Note that the triazole fungicide products were not applied specifically as chemical plant growth regulator products; they were included in the trial to demonstrate any issues when such products are used for disease control on bedding plants.*

The spray treatments were applied in approximately 1,000 litres of water per hectare via a small pump action hand held sprayer (to the point of run-off from the foliage). The drench treatment was applied at 75 ml of solution per litre pot via a watering can

and washed off the foliage afterwards. All applications were made in the late afternoon / early evening.

Plant height or width as appropriate was recorded to monitor change in plant growth over time in comparison with the untreated control and the Bonzi treatment included as a reference to standard commercial practice. Notes of any phytotoxic damage and time to flower were also recorded.

Good levels of growth control were achieved with **Regalis**, although flower petal bleaching occurred on some plant species. It may be that earlier applications of the product (soon after transplanting, or even at the plug stage, though this will require further examination) may be a suitable method of reducing the unwanted side effect. The symptoms recorded in the trial were less than those recorded in other trials undertaken by BASF and symptoms were totally avoided in the case of petunia multiflora 'Dreams Blue'. The drench treatment and two-spray treatments were generally more effective than a single spray treatment. An extension to the SOLA to include protected ornamental crops would be a useful addition.

**Cerone** was very effective with a number of the plant species but may prove excessive with some species, such as dahlia (see image on next page). As a result of its mode of action (it breaks down within the plant to release ethylene gas) it appeared to delay flowering with several species, by 10 days in verbena, 4 days in dahlia and 2 days in fuchsia. Such a relatively severe delay with verbena may be due to the product getting into the growing medium at the point of application (the plants were relatively small at treatment) exacerbating its effect on the plant. The continuation of the SOLA provides a potentially useful alternative product to growers.

**Moddus** was the least effective at controlling growth and caused more petal bleach (see image on next page) than Regalis (to which it is chemically related). As a stand-alone product it has limited potential use for growth control in bedding plants.

The results from the trial also indicate that some triazole fungicides used for disease control should be applied with care, although they don't all impact on plant growth to the same level. The application of **Bumper 250 EC** for rust control on bedding and pot plants (under SOLA 0707/2009) for example could potentially result in a severe check to growth and even phytotoxic damage to flowers and growing points (see images on next page). **Sythane 20 EW** on the other hand had very little impact on

plant growth and produced no phytotoxic damage to the plant species examined in the trial.

An overview of the effects of each treatment is included in the following tables. Overall it was clear that the chemical applied, the application method and frequency as well as the species treated will all impact the results achieved. The data from this trial provides some overall guidance but it is important for growers to carry out their own small scale trials before applying any of the treatments tested here to large scale areas of commercial production.

### Phytotoxic symptoms noted during the trial



Begonia – flower distortion in response to applications of Bumper 250 EC



Fuchsia – growing point hardening in response to applications of Bumper 250 EC



Dahlia – flower stem shortening in response to applications of Cerone



Verbena – untreated v Moddus sprays (right), giving rise to petal bleach

**Summary of response to growth regulators and two fungicides by plant species**

<b>Species</b>	<b>Bonzi</b>	<b>Regalis</b>	<b>Cerone</b>	<b>Moddus</b>	<b>Bumper 250 EC</b>	<b>Systhane 20 EW</b>
<b>Begonia semperflorens 'Big'</b>	Obvious height reduction. No improvement in habit. Possible flower delay. Foliage darkened.	No obvious effect from x 1 spray treatment. x 2 spray treatment more effective, improvement in branching, some petal bleach though. Height reduction from drench treatment. No delay in flowering.	Obvious height reduction, comparable to Bonzi treatment.	Slight check to growth, possibly a paling of flower petals.	Obvious height reduction, very dark leaves but distortion to flowers (and growing points) noted. Delay in flowering.	Limited effect on plant growth or habit.
<b>Dahlia 'Gallery - Renoir Pink'</b>	Obvious height reduction, plants at least a third smaller. Leaf and flower size reduction. Flowers still borne above foliage.	x 1 spray treatment limited effect. Height reduction with x 2 spray treatment, obvious effect from drench. Flower petal bleach in response to x 2 spray and drench treatment. Flower stems shortened, flowers only just above foliage with drench. Foliage darkened with drench.	Obvious early growth control. Stems of first flush of flowers held back so that open flowers below foliage. Some delay in flowering, flower and leaf size reduced.	No affect in terms of plant height, but plants appear more upright in habit. Flower petal bleach obvious.	Plant upright in appearance, flowers smaller in size, slight height reduction.	No effect on plant growth or habit.
<b>Dianthus 'Select - Whitefire'</b>	Slight height reduction noted, slightly better branching gives rise to better plant habit.	Height reduction noted, but no improvement in plant habit. Delay in flowering with most treatments.	Improved plant habit, more branching and flower stems, good shape to the plants. Very slight reduction in plant height.	No impact on growth. Possible delay in flowering.	Darker foliage, significant reduction in height. Possible delay in flowering.	No effect on plant growth or habit.
<b>Fuchsia 'Mojo - Deep Cerise and Pastel Violet'</b>	Height reduction noted but not statistically significant, flowers well displayed. Slight reduction in flower size, either earlier flowering or flowering enhanced relative to other treatments.	No or very limited effect in terms of growth control with all treatments. Delay in flowering.	Comparable to Bonzi treatment in terms of height and growth control, but flowering not enhanced in the same way.	Some effect in terms of height control, possible delay in flowering.	Well branched, but transient growing point distortion noted. Good habit to plant, delay in flowering.	No effect on plant growth or habit.

Species	Bonzi	Regalis	Cerone	Moddus	Bumper 250 EC	Systhane 20 EW
<b>Geranium 'Black Velvet - Scarlet'</b>	Height reduction noted but not statistically significant, also reduction in leaf size. Intensifies the purple colouration in the leaf (darker leaves). No improvement in habit.	Variable effect on height control, no improvement in overall habit. Some leaf size reduction with drench and possible flower delay.	Height reduction noted but not statistically significant with improvement in number of side breaks.	Limited effect on growth and habit. Breaks up leaf margin zonal markings. Possible delay in flowering.	Limited growth control and slight intensification of leaf markings.	No effect on plant growth or habit. Possible delay in flowering.
<b>Impatiens 'Envoy - White'</b>	Tighter growth habit and perhaps a darkening of the foliage.	Variable effect on growth, possibly some distortion with higher rates. Possible delay in flowering.	Limited effect in terms of height control, plants appear more upright in habit.	Limited effect, plants appear more upright.	Limited effect on growth and habit.	No effect on plant growth or habit.
<b>Marigold 'Dorango - Tangerine'</b>	Slightly tighter canopy to plant, no obvious differences.	Slight response to x 2 spray treatment and drench treatment in terms of habit.	Some improvement in level of side branching and slight reduction in flower stem length.	No effect.	Slightly tighter growth habit to the plants.	No effect on plant growth or habit.
<b>(Petunia) Surfinia 'Classic Vanilla'</b>	Good leaf cover over the pot, slightly darker leaves.	x 1 spray treatment limited effect, improvement in habit with x 2 spray and drench treatment.	Obvious reduction in leaf size, possible reduction in flower size. Better habit to plants, less sprawling.	Darker foliage, some check to growth, plants less sprawling.	Improvement in growth habit, plants slightly less sprawling, darkening of foliage.	No effect on plant growth or habit. Plant more open in centre, more yellow leaf noted.
<b>Petunia multiflora 'Dreams Blue'</b>	Limited effect of treatment, perhaps slightly darker foliage and possibly earlier flowering.	No effect from x 1 spray treatment. Some height control and habit improvement with x 2 spray treatment and drench. Second spray treatment may have affected growing points – slight yellowing and distortion.	Some effect on height, habit appears slightly improved.	Good shape to plants, with only limited level of growth reduction.	Reduced level of branching noted, plants less well developed.	No effect on plant growth or habit.
<b>Salvia 'Mohave'</b>	Darker leaves, improved branching with very slight growth control.	Limited effect with all 3 treatments.	Possibly more branching and a reduction in flower stem length and flower size.	Good level of branching, very limited effect on height.	Very limited effect on growth, foliage slightly darker.	No effect on plant growth or habit.
<b>Verbena 'Tamari Trailing Blue'</b>	Tighter habit to the plant with more growth from the centre of the plant. Darker foliage.	Limited effect in terms of growth control and habit improvement. Some petal bleach with treatments.	Some height control, plants more upright in habit as opposed to sprawling. Delay in flowering.	No effect on growth, flower petal bleach noted.	Some height control noted, foliage darkened.	No effect on plant growth or habit.

## Financial benefits

It is crucial that a range of chemical plant growth regulator products are available in case any of the three main active ingredients (chlormequat, daminozide or paclobutrazol) are lost to the industry for any particular reason. The option to use Regalis or Cerone over protected ornamental crops is therefore important to maintain the ability to respond quickly to market demands, changes in weather etc. and control plant growth to adhere to the required retailer plant specifications and minimise plant wastage levels.

In terms of costs relative to Bonzi, the alternative products examined in the trial are either similar in price or less expensive (see summary table below).

### ***Approved status and relative costs of growth regular treatments examined in the trial (2010)***

Product	Approval status		Average cost of product	Cost per litre of solution at rate trialled
	Outdoor	Protected		
Bonzi	✓(Label)	✓(Label)	6.9p per ml of product	8.6p per litre at 1.25 ml / litre rate
Regalis	✓(SOLA)		8.2p per gram of product	10.3p per litre at 1.25 g / litre rate
Cerone		✓(SOLA)	1.7p per ml of product	1.7p per litre at 1.0 ml / litre rate
Moddus	SOLA required for use on ornamentals.		4.6p per ml of product	1.8p per litre at 0.4 ml / litre rate

## Action points for growers

- Check the published literature review which forms part of this project for further detail about other research work undertaken with the products examined in the trial. (See Appendix 1 of the full report for this project)
- If appropriate, trial Regalis and or Cerone on a small number of plants from a range of different plant species to become familiar with the responses they induce (note Regalis can only currently be applied to outdoor ornamental crops).

- Contact the HDC to enquire about the extension of the Regalis SOLA beyond 2011 and the potential for protected ornamental crops to be also included on the SOLA.