

# POTENTIAL ADDITIVE GROWTH REGULATOR EFFECTS OF TRIAZOLE FUNGICIDES ON BEDDING PLANTS TREATED WITH GROWTH REGULATORS

Thomas J. Banko<sup>1</sup>

## ABSTRACT

Fungicides such as triadimefon and propiconazole are chemically very similar to triazole growth regulators (PGRs) frequently used during bedding plant production. The possibility of additive or synergistic effects when fungicides and PGRs are both applied was investigated. Seedlings of *Viola ×wittrockiana* (pansy), *Petunia ×hybrida*, and *Catharanthus roseus* (annual vinca) were grown in a greenhouse and treated with the PGRs paclobutrazol or uniconazole. The fungicides triadimefon or propiconazole were applied as sprays in a factorial experiment. Both fungicides reduced plant width and root dry weight of petunia, and triadimefon reduced width and root dry weight of pansy. For annual vinca, a physiological leaf spot occurred on all plants treated with triadimefon, but with propiconazole, the leaf spot occurred only on plants also treated with a PGR. These results suggest care should be taken in applying triazole fungicides to bedding plants that have been treated with a PGR, as additional growth suppression or other unintended results may occur.

## INTRODUCTION

Over the past few years several triazole derivatives, collectively described as sterol biosynthesis inhibitors, have been developed for use either as plant growth regulators or as fungicides. Examples which have become commercially available include triadimefon (Bayleton) and propiconazole (Banner) developed as fungicides and, paclobutrazol (Bonzi) and uniconazole (Sumagic) developed as growth retardants. However, all of these products can exhibit both fungicidal and growth regulating properties to varying degrees (Fletcher, 1986). Triadimefon has inhibited growth of broad bean at or above rates therapeutic for rust (Tüske, 1983), while myclobutanil (Systhane) and other triazole fungicides have retarded growth of New Guinea impatiens (Lee, 2000). Propiconazole (Banner) reduced leaf area of pecan leaves (Wetzstein, 2002) and retarded early seedling growth of redroot pigweed (Hanson, 2003). Plant growth regulators (PGRs) are commonly used during greenhouse and nursery production of flowering bedding plants. Fungicides are also likely to be applied to prevent or control diseases during production. The purpose of this study was to investigate possible PGR/fungicide additive or interactive effects resulting from applications of these two groups of chemicals.

## MATERIALS AND METHODS

Plants used in this study included *Catharanthus roseus* (L.) G. Don. 'Little Bright Eyes' (annual vinca), *Petunia ×hybrida* hort. Vilm.-Andr. 'Bravo Pink' (petunia), and *Viola ×wittrockiana* Gams. 'Universal Plus Violet Blotch' (pansy). Plants were potted into 1.9 liter containers in a pine bark medium, fertilized with Osmocote 14-14-14 (12 g per container), and placed on greenhouse benches. Irrigation was provided with an automatic system utilizing spray stakes in each container. Growth regulator (PGR) treatments were applied when plants resumed active growth, approximately two weeks after potting. These included 15 ppm Bonzi or 5 ppm

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<sup>1</sup> Virginia Tech, Hampton Roads Agricultural Research and Extension Center, 1444 Diamond Springs Road, Virginia Beach, VA 23455-3363 USA

Sumagic applied to the vinca, 60 ppm Bonzi or 30 ppm Sumagic to petunia, and 10 ppm Bonzi or 5 ppm Sumagic applied to pansy. Water spray control treatments were also included for all three species. One week after the PGR applications, fungicide treatments were applied. The fungicides included Banner Maxx at 8 oz. per 100 gal. (0.6 ml/liter) or Bayleton 50 at 5.5 oz. per 100 gal. (0.41 g/liter) applied to the *Catharanthus* and pansy, and Banner Maxx at 12 oz. per 100 gal. (0.9 ml/liter) or Bayleton 50 at 5.5 oz. per 100 gal. (0.41 g/liter) applied to petunia. Water spray control treatments were included for all species. The fungicide treatments were reapplied two weeks after the first application to the pansies and petunias. A split plot experimental design was utilized with the PGR treatments as the main plots and the fungicides as sub-plots. The experiments were conducted separately for each species and analyzed as separate experiments. There were four replications with three plants per treatment for each replication. The replications were blocked by plant size at the beginning of each experiment. Treatments for the pansy experiment were applied in Feb. 2002. The petunia and *Catharanthus* experiments were started in March and August, respectively. Data collected included plant heights and widths, numbers of open flowers, and root and shoot dry weights. Visual ratings for a physiological leaf spot which occurred on *Catharanthus* with certain treatments were also obtained. These data were collected one month after the PGR applications for pansy and petunia, and 2 weeks after PGR applications for *Catharanthus*. Data were analyzed as a factorial experiment using SAS ANOVA, with mean separations, where appropriate, by LSD, P=0.05.

## RESULTS AND DISCUSSION

There were no significant PGR by fungicide interaction effects on growth, however, both PGRs and fungicides affected growth independently. For the pansies Sumagic (5 ppm) reduced plant height more than Bonzi (10 ppm), and both significantly reduced plant widths compared to the controls. The fungicide Bayleton also caused a reduction in plant widths, in addition to reduced shoot and root dry weights evaluated over all PGR treatments (Table 1).

Table 1. Main effects of PGR and fungicide applications to pansy 'Universal Plus Violet Blotch' 4 weeks after PGR treatments.

Treatment	Height (cm)	Width (cm)	Flower number	Shoot wt. (g)	Root wt. (g)
PGR					
Control	10.4a <sup>z</sup>	18.3a	2.9	4.0	0.37
Bonzi (10ppm)	9.8ab	16.7b	2.1	3.8	0.36
Sumagic (5ppm)	9.5b	16.3b	3.3	3.5	0.31
			NS	NS	NS
Fungicide					
Control	10.1	18.1a	3.6	4.3a	0.41a
Banner Maxx (8 oz) <sup>y</sup>	10.1	17.3ab	2.7	3.8ab	0.34ab
Bayleton 50 (5.5 oz)	9.5	15.9b	1.9	3.2b	0.30b
	NS		NS		

<sup>z</sup> Mean separations within each main effect by LSD, P = 0.05. NS = no significant difference at P = 0.05.

<sup>y</sup> Fungicide rates per 100 gal., applied twice at a two-week interval.

Sumagic being the more effective of the two. There were no significant PGR effects on plant widths, flower numbers, or shoot and root dry weights, however, both Banner Maxx and Bayleton fungicides reduced plant widths, and shoot and root dry weights (Table 2).

Table 2. Main effects of PGR and fungicide applications to petunia 'Bravo Pink' 4 weeks after PGR treatments.

<b>Treatment</b>	<b>Height (cm)</b>	<b>Width (cm)</b>	<b>Flower number</b>	<b>Shoot wt. (g)</b>	<b>Root wt. (g)</b>
<b>PGR</b>					
Control	19.4a <sup>z</sup>	22.1	16.5	8.7	1.3
Bonzi (60ppm)	17.7ab	21.2	16.4	8.7	1.6
Sumagic (30ppm)	15.9b	21.1	18.4	8.1	1.4
		NS	NS	NS	NS
<b>Fungicide</b>					
Control	17.9	22.8a	18.2	9.0a	1.7a
Banner Maxx (8 oz.) <sup>y</sup>	17.2	20.4b	16.5	7.9b	1.3b
Bayleton 50 (5.5 oz)	17.9	21.2b	16.6	8.6ab	1.4b
	NS		NS		

<sup>z</sup> Mean separations within each main effect by LSD, P = 0.05. NS = no significant difference at P = 0.05.

<sup>y</sup> Fungicide rates per 100 gal., applied twice at a two-week interval.

*Catharanthus* height was reduced by Sumagic (5 ppm) but not by Bonzi (15 ppm) two weeks after application (Table 3) but by four weeks, there were no differences among treatments (data not shown). The fungicides had no effect on heights or widths, however, there was a PGR

Table 3. Main effects of PGRs applied to *Catharanthus* 'Little Bright Eyes' two weeks after treatment.

<b>PGR</b>	<b>height (cm)</b>	<b>width (cm)</b>	<b>Flower number</b>	<b>Shoot wt. (g)</b>	<b>Root wt. (g)</b>
Control	22.4a <sup>z</sup>	17.8	4	10.2	4.3
Bonzi (15 ppm)	23.2a	18.8	4	10.7	4.0
Sumagic (5 ppm)	19.7b	17.4	4	10.3	3.9
		NS	NS	NS	NS

<sup>z</sup> Mean separation by LSD, P = 0.05. NS = no significant difference at P = 0.05.

by fungicide interaction affecting the development of a physiological leaf spot on *Catharanthus*. Bayleton alone or in combination with either Bonzi or Sumagic caused moderate to severe leaf spotting (Fig. 1). Banner Maxx applied alone caused no leaf spotting but when applied after applying Sumagic there was minor leaf spotting and, when applied after applying Bonzi, there was a moderate amount of leaf spotting (Table 4).

Table 4. *Catharanthus* leaf spotting interaction response to application of triazole PGRs and triazole fungicides.

<b>Fungicide</b>	<b>Growth regulators</b>		
	<b>No PGR</b>	<b>Bonzi (15 ppm)</b>	<b>Sumagic (5 ppm)</b>
No fungicide	1.0a <sup>z</sup>	1.9a	1.3a
Banner Maxx (8 oz.) <sup>y</sup>	1.3a	2.8b	1.8b
Bayleton 50 (5.5 oz.)	3.2b	3.4c	3.3c

<sup>z</sup> Leaf spot ratings: 1 = no spots, 2 = minor spotting, 3 = moderate spotting, 4 = severe spotting. Mean separation within columns by LSD, P = 0.05.

<sup>y</sup> Fungicide rates per 100 gal., one application.



Fig. 1. Physiological leaf spot which developed on *Catharanthus* 'Little Bright Eyes' following application of Bayleton 50 (5.5 oz/100 gal) with or without previous PGR application or, following application of Banner Maxx (8 oz./100 gal.) to plants previously treated with Bonzi.

## CONCLUSIONS

These results show that triazole fungicides are likely to provide growth retardation in addition to that obtained from a previously applied PGR. This is not necessarily detrimental but should be taken into consideration when selecting PGR application rates or class of fungicides. In addition, leaf spotting is likely

to occur on *Catharanthus* with applications of Bayleton or, with Banner Maxx in combination with Bonzi or Sumagic.

## LITERATURE CITED

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