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IR-4 Ornamental Horticulture Program PGR Effect on Shelf Life of Herbaceous Ornamental Crops

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Acknowledgements

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Abstract

Potted plants like geranium and impatiens are typically grown in the warmer regions of the United States and require shipping to reach northern markets for sale to homeowners. Stresses such as darkness, temperature fluctuations and increased ethylene levels during shipment may accelerate plant senescence when they reach retail benches. Decreases in plant quality characterized by bud and flower drop, leaf yellowing and abscission, and greater susceptibility to stresses such as drought at retail locations are common problems resulting in considerable losses. Development and registration of plant growth regulators (PGR's) that help overcome shipping stress, and enhance shelf life quality are of great interest to the potted ornamental horticulture industry. At the IR-4 2005 Annual Workshop, evaluating products to enhance shelf quality and display life of potted ornamentals became a high priority project within the PGR discipline.

From 2006 through 2010, ten products representing six different active ingredients were tested for enhanced shelf life in potted ornamental species including potted geranium, impatiens, New Guinea impatiens, poinsettia and tulip. Six active ingredients 1) ABA, 2) 6-BA, 3) GA₄₊₇, 4) 6-BA + GA₄₊₇, 5) thidiazuron and 6) sodium silver thiosulfate were identified as promising for this research and compared to the standard 1-methylcyclopropene (EthylBloc). Some products (Configure) were in development for use on ornamentals while others (Argylene, MaxCel/Exilis Plus, Fascination/Fresco, NovaGib/Provide, TDZ) have been registered with the EPA for other uses.

The GA₄₊₇ products generally were not phytotoxic to geranium and had some positive effects but increased height and peduncle length were unacceptable. Products containing 6-BA at 100 ppm caused significant injury on geranium which varied by cultivar. Limited testing on New Guinea impatiens and *Impatiens walleriana* suggests that ABA applications may improve days to wilting on select varieties. GA₄₊₇ treatments to *Impatiens walleriana* increased flower number but caused stretch in both *Impatiens walleriana* and New Guinea impatiens. A single experiment involving TDZ treatments at 5 and 10 uM showed promise in improving geranium and poinsettia postharvest life although it delayed flowering in geranium. Limited testing with TDZ and Fascination (6-BA+GA₄₊₇+6-BA) suggest beneficial effects on *Tulip sp.* Results are not adequate at this time to consider registration of any of the products tested on any of the herbaceous species studied. Further research is needed to fine tune rates and test new products as they become available.

Introduction

Potted plants like geranium and impatiens are typically grown in the southern states and shipped to the northern markets for sale to homeowners. Stresses such as darkness, temperature fluctuations, and ethylene build up during shipment may accelerate plant senescence after they are displayed on retail benches. Plants may exhibit bud and flower drop, leaf yellowing and abscission, or become more susceptible to stresses such as drought at retail locations. Development and registration of PGRs that may help overcome shipping stress, and enhance shelf quality and display life of potted ornamentals are of great interest to the ornamental industry. At the 2005 Annual Workshop, screening a number of products to enhance shelf and display life of potted herbaceous ornamentals became one of the high priority projects for the PGR discipline. The following research was conducted between 2006 and 2010

Materials and Methods

Ten plant growth regulators were tested to determine their effects on shelf life of various cultivars of geranium, impatiens, poinsettia and tulip grown in pots (Table 1). However, not all products were tested on all plant species. All products except EthylBloc were applied once as heavy foliar sprays (srenches) typically at flowering 1 to 2 days before simulated shipping. EthylBloc was applied in an interior room as a gas at 1 ppm for 4 to 16 hours just prior to “simulated shipping”. After treatment, plants were placed in cardboard boxes and moved to a room maintained at approximately 20 °C to simulate shipping for 2 to 4 days in darkness. These were then placed on display in a simulated interior environment for evaluation of their postharvest performance. A minimum of six plants (replicates treatments) were required with some researchers exceeding this minimum. In these experiments, the assessments typically made were number of flowers, plant size, leaf yellowing and abscission, flower bud development and abscission, flower stem length, visual quality (0 to 10 scale with 0 being unsalable and 10 being highly attractive) and phytotoxicity, (with 0 being no phytotoxicity and 10 being plant death) taken at various times after treatment and simulated shipping. In some experiments plants were actually shipped from the point of origin to the researcher. For more detailed materials and methods, including application rates for various products, please see Appendix 1: Protocols. Products were supplied to researchers (See list of researchers in Appendix 2) by their respective manufacturers.

Table 1. List of Products and Rates Tested in 2006 and 2010.

Product	Active Ingredient(s)	Manufacturer	Rates^z	# Trials
Argylene	Sodium silver thiosulfate	No Manufacturer	0.5 mM	4
Configure	6-Benzyladenine	Fine Americas, Inc.	5, 10, 20 ppm	1
Dropp	Thidiazuron	Bayer Crop Science	5, 10 uM	4
Exilis Plus	6-Benzyladenine	Fine Americas, Inc.	50, 100 ppm	1
EthylBloc	1-methylcyclopropene	Floralife, Inc.	1 ppm	6
Fascination	6-Benzyladenine + Gibberellins A ₄ + A ₇	Valent USA Corp.	50, 100 ppm	12
Fresco	6-Benzyladenine + Gibberellins A ₄ + A ₇	Fine Americas, Inc.	500 ppm	1
MaxCel	6-Benzyladenine	Valent USA Corp.	50, 100 ppm	10
NovaGib	Gibberellins A ₄ + A ₇	Fine Americas, Inc.	50, 100 ppm	2
Provide	Gibberellins A ₄ + A ₇	Valent USA Corp.	100 ppm	8

Results and Summary



Comparative Efficacy on Geranium (Pelargonium spp.)

In 2006 and 2007, seven researchers examined the effect of ten PGR's on enhancing plant quality and improving shelf life of several potted geranium cultivars after simulated shipping. The products tested included Argylene XM, Fascination/Fresco, MaxCel/Exilis Plus, Configure, Provide/NovaGib 10L and Dropp. EthylBloc was typically used as a standard. All treatments were applied once as heavy foliar sprays (srenches) typically at 100 ppm when plants reached flowering stage 2 to 4 days before simulated shipping. EthylBloc was applied in an interior room as a gas at 1 ppm for 4 to 16 hours just prior to simulated shipping. After treatment, plants were placed in cardboard boxes and moved to a room maintained at approximately 20 °C to simulate shipping for 2 to 4 days in darkness. These were then placed on display in a simulated interior environment for evaluation of their postharvest performance. In these experiments, the assessments typically made were number of flowers, plant size, leaf yellowing and abscission, flower stem length, visual quality and phytotoxicity taken at various times after foliar spray.

Although not consistent in all experiments, products containing 6-BA (Fascination/Fresco, Maxcel/Exilis Plus) at 100 ppm caused significant injury that negatively affected plant quality and shelf life of various cultivars (Table 2). This injury was exhibited as marginal chlorosis and necrosis. The extent of phytotoxicity varied from none to significant with different cultivars. Improvement in plant quality and shelf life from these PGR's were variable because of their phytotoxicity. In some cases a treatment was found to deliver an advantage, as well as, a disadvantage. The GA₄₊₇ products (NovaGib and Provide) generally were not phytotoxic and had positive effects in some studies; however, they increased peduncle length at 100 ppm which in some cases was considered unacceptable. Dropp improved plant quality and shelf life in three of four experiments although results varied by variety (Table 20, Table 30, Figure 36). A distinct delay in flowering was noted by one researcher suggesting that this product would need to be applied at the full color stage. Argylene in this trial provided mixed results, increasing leaf yellowing in 'Tutti Frutti' and decreasing leaf abscission in 'Tango'. The standard EthylBloc generally had no effect probably because plants were not specifically ethylene-stressed after the EthylBloc application. In the absence of ethylene, EthylBloc often shows no effect. In general, researchers were encouraged with the potential of products containing GA₄₊₇ to improve shelf life of potted geranium. Additional research would be needed to determine concentrations and application details for maximum effectiveness.

Table 2. Phytotoxicity Summary for Geranium by Variety by Product

Geranium Variety	Treatment							
	Maxcel 6 BA	Exilis 6 BA	Fascination 6 BA + GA ₄₊₇	Fresco 6 BA + GA ₄₊₇	Provide GA ₄₊₇	Novagib GA ₄₊₇	Configure ABA	Dropp thidiazuron
Freestyle Pink Ivy type	Significant (1) ^a	*** ^c	Significant (1)	***	None (1)	***	***	***
Tutti Frutti Ivy type	Significant (4:4) ^b	Significant (1)	Significant (3:4)	***	None (4)	None (1)	***	***
Ringo Salmon Ivy type	Significant (2:4)	None (1)	Significant (3:4)	Significant (1)	None (3)	None (1)	None (1)	None (3)
Tango Zonal type	Significant (4:4)	Moderate (1)	Significant (3:4)	***	None (3)	None (1)	***	***
Survivor Red Zonal type	Significant (1)	***	Significant (1)	***	None (1)	***	***	***
Maverick Coral Zonal type	Significant (1)	***	Significant (1)	***	None (1)	***	***	***
Maverick Pink Zonal	Significant (3:4)	None (1)	Significant (3:5)	Significant (1)	None (3)	None (1)	None (3)	None (3)
Maestro Bright Red Zonal type	Moderate (1:2)	***	Moderate (1:2)	***	None (1)	***	None (1)	None (1)
Pinto Red Zonal	None (1)	***	None (1)	***	***	***	***	***
Startrack Purple	Significant (1)	***	None (1)	Significant (1)	***	Moderate (1)	***	***

^a total number of experiments.^b number of experiments with injury out of total number of experiments with that variety.^c *** means combination not tested.

Chen 2006

In 2006, Chen conducted an experiment to determine the effect of five products on shelf life of geranium cultivars ‘Cascade Hot Pink’, ‘Holiday Purple’, ‘Startrack Purple’ and ‘Startrack Violet’. Fascination, Fresco, Maxcel and NovaGib were applied at 100 ppm, and the standard EthylBloc at 1 ppm. After treatment, plants were boxed and kept in dark at 4 C° for 2 days (day 1 and 2) to simulate shipping. Phytotoxicity rating was taken on day 3, and number of flowers and overall plant quality rating were evaluated on day 7, 14, and 21.

There were no significant differences among treatments until day 14; and the standard EthylBloc and untreated control had the best flower displays. In general, PGR treatments resulted in less ideal performance than the standard and untreated control. Phytotoxicity was observed with Fascination, Fresco and NovaGib. Table 3 shows flower number and phytotoxicity data for the cultivar ‘Startrack Purple’; the other three varieties responded similarly.

Table 3. Effect of several PGR's on Number of Flowers and Phytotoxicity of Geranium (*Pelargonium* sp.) ‘Startrack Purple’, Chen, 2006.

Treatment	Average Total Number of Flowers ^z				Phytotoxicity
	Day 0 ^y	Day 7	Day 14	Day 21	
Fascination (6-BA + GA ₄₊₇ + 6-BA) 100 ppm	18.5	14.1	3.5 bc	0.4 cd	2.5
Fresco (6-BA + GA ₄₊₇ + 6-BA) 100 ppm	26.9	16	8.5 bc	7.1 bc	3.6
MaxCel (6-BA) 100 ppm	26.9	24.6	9.6 b	11.8 ab	0
NovaGib (GA ₄₊₇) 100 ppm	22.8	18.7	3.2 c	0 d	0.7
EthylBloc (1-MCP) 1 ppm	24.6	22.9	16.6 a	6.7 ab	0
Untreated	26.6	17.8	16.1 a	12 ab	0
LSD _{0.05}	NS	NS	0.0001	<0.0001	0.0034

^z Means in the same column followed by the same letter are not significantly different, (P = 0.05, LSD test).

^y Day 0 is 1 day before treatment when plants showed 1-3 open flowers.

Pemberton 2006

In 2006, Pemberton conducted an experiment to determine effect of four products on shelf life of geranium cultivars ‘Freestyle Pink’ (vegetative ivy type), ‘Maverick Coral’ (seed zonal type), and ‘Survivor Red’ (vegetative zonal type). Fascination, Maxcel and Provide were applied as foliar sprays at 100 ppm and the standard EthylBloc was applied as a gas at 1 ppm. Two days after treatment, plants were subjected to simulated shipping (21C in the dark for 48 hours) and moved to an interior postharvest evaluation room.

For most of the later evaluation dates during the postharvest evaluation period, Provide maintained performance and flower number better than the control for ‘Freestyle Pink’, ‘Maverick Coral’, and ‘Survivor Red’ (Table 4 - Table 6). Fascination also resulted in better performance and flower number, but on ‘Survivor Red’ only. MaxCel caused strong phytotoxic symptoms on the seed grown ‘Maverick Coral’, moderate symptoms on ‘Freestyle Pink’, and negligible symptoms on ‘Survivor Red’, both vegetative types. The other product containing 6-BA (Fascination) also resulted in some symptoms of phytotoxicity, especially for ‘Maverick Coral’. The main symptom observed was leaf burning.

Products containing GA₄₊₇ may be useful for increasing flowering during the postharvest period as long as plants don't remain on the shelf for an extended period. This effect could also depend on the retail environment light levels and the use of growth retardants prior to harvest.

Table 4. Effect of several PGR's on the Postharvest Performance of Ivy Geranium (*Pelargonium* sp.) 'Freestyle Pink', Pemberton, 2006

Treatment ^a	Evaluation Date				
	6/27/06 ^y	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄₊₇)	7.1	7.0	6.1 b	6.5 bc	5.9 b
MaxCel (6-BA)	7.3	6.8	5.9 b	5.9 c	5.1 c
ProVide (GA ₄₊₇)	7.1	7.4	6.9 a	7.5 a	7.0 a
EthylBloc (1-MCP)	7.4	7.1	6.9 a	6.1 bc	5.6 bc
Untreated	7.3	6.9	7.1 a	6.6 b	6.0 b
ANOVA	NS	NS	**	**	**
Number of Flowers					
Fascination (6-BA + GA ₄₊₇)	2.6	2.8	2.3 b	1.4 b	0.8 b
MaxCel (6-BA)	3.1	3.0	1.9 b	0.3 c	0.1 c
ProVide (GA ₄₊₇)	2.9	3.3	4.0 a	2.5 a	2.1 a
EthylBloc (1-MCP)	3.4	3.0	2.3 b	0.3 c	0.0 c
Untreated	3.0	2.9	3.4 ab	0.5 c	0.0 c
ANOVA	NS	NS	*	**	**
Phytotoxicity					
Fascination (6-BA + GA ₄₊₇)		1.4 b	2.3 a	1.9 a	
MaxCel (6-BA)		2.0 a	2.5 a	2.3 a	
ProVide (GA ₄₊₇)		1.0 c	1.0 b	1.0 b	
EthylBloc (1-MCP)		1.0 c	1.0 b	1.0 b	
Untreated		1.0 c	1.0 b	1.0 b	
ANOVA		**	**	**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^b Performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering. For example, 5 = uneven growth, several flowers, moderate form and habit; 8 = uniform growth, moderate height, many flowers, superior form and habit; 10 = uniform growth, compact height, uniform full flowering, superior form and habit.

Table 5. Effect of several PGR's on the Postharvest Performance of Zonal Geranium (*Pelargonium* sp.) 'Maverick Coral', Pemberton, 2006

Evaluation Date					
Treatment ^a	6/27/06 ^y	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄ + 7)	8.6 a	6.1 b	5.6 b	5.9 c	5.1 c
MaxCel (6-BA)	8.0 c	6.4 b	5.0 c	5.6 c	4.9 c
ProVide (GA ₄ + 7)	8.0 c	8.4 a	8.0 a	7.8 a	7.8 a
EthylBloc (1-MCP)	8.1 bc	8.5 a	7.5 a	7.3 b	6.1 b
Untreated	8.5 ab	8.4 a	7.8 a	7.1 b	6.1 b
ANOVA	*	**	**	**	**
Number of Flowers					
Fascination (6-BA + GA ₄ + 7)	5.6	6.3	6.3	6.6 a	5.0 a
MaxCel (6-BA)	4.0	4.3	4.8	2.6 c	0.4 c
ProVide (GA ₄ + 7)	4.9	5.0	5.8	5.6 ab	4.5 a
EthylBloc (1-MCP)	4.4	4.8	5.6	3.8 c	1.8 b
Untreated	5.4	5.9	6.9	4.3 bc	2.1 b
ANOVA	NS	NS	NS	**	**
Phytotoxicity					
Fascination (6-BA + GA ₄ + 7)		3.5 a	3.5 b	3.3 a	
MaxCel (6-BA)		3.0 b	4.1 a	2.9 a	
ProVide (GA ₄ + 7)		1.0 c	1.0 c	1.1 b	
EthylBloc (1-MCP)		1.0 c	1.0 c	1.0 b	
Untreated		1.0 c	1.0 c	1.6 b	
ANOVA		**	**	**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^b Performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering. For example, 5 = uneven growth, several flowers, moderate form and habit; 8 = uniform growth, moderate height, many flowers, superior form and habit; 10 = uniform growth, compact height, uniform full flowering, superior form and habit.

Table 6. Effect of several PGR's on the Postharvest Performance of Zonal Geranium (*Pelargonium* sp.) 'Survivor Red', Pemberton, 2006

Evaluation Date					
Treatment ^a	6/27/06 ^y	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄₊₇)	7.9	8.6 a	7.9 b	7.8 a	6.4 ab
MaxCel (6-BA)	7.6	7.6 b	7.1 bc	6.0 b	5.5 c
ProVide (GA ₄₊₇)	7.9	8.6 a	7.9 a	7.8 a	6.9 a
EthylBloc (1-MCP)	8.1	8.1 ab	6.6 cd	6.4 b	6.0 bc
Untreated	7.6	7.6 b	6.5 d	6.3 b	5.9 bc
ANOVA	NS	*	**	**	**
Number of Flowers					
Fascination (6-BA + GA ₄₊₇)	5.3 a	5.4 a	5.5 a	4.0 a	3.0 a
MaxCel (6-BA)	2.6 bc	2.8 b	3.9 bc	1.0 b	0.1 b
ProVide (GA ₄₊₇)	4.4 ab	4.8 a	4.9 ab	4.5 a	3.3 a
EthylBloc (1-MCP)	4.0 ab	4.0 ab	2.9 c	0.8 b	0.4 b
Untreated	2.1 c	2.9 b	3.1 c	0.3 b	0.1 b
ANOVA	**	*	**	**	**
Phytotoxicity					
Fascination (6-BA + GA ₄₊₇)		1.4 b	2.3 a	1.8 a	
MaxCel (6-BA)		1.8 a	2.0 a	1.1 b	
ProVide (GA ₄₊₇)		1.0 c	1.0 b	1.0 b	
EthylBloc (1-MCP)		1.0 c	1.0 b	1.0 b	
Untreated		1.0 c	1.0 b	1.0 b	
ANOVA		**	**	**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^b Performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering. For example, 5 = uneven growth, several flowers, moderate form and habit; 8 = uniform growth, moderate height, many flowers, superior form and habit; 10 = uniform growth, compact height, uniform full flowering, superior form and habit.

Chen 2007

In 2007, Chen conducted an experiment to determine the effect of five products on shelf life of ivy geranium ‘Tutti Frutti’ and zonal geranium ‘Tango’. Exilis Plus, Fascination, Maxcel and NovaGib were applied at 50 and 100 ppm, and EthylBloc at 1 ppm. Ivy geranium and zonal geranium responded differently to PGR treatments. In general, higher phytotoxicity was observed with ivy geranium compared to zonal geranium (Table 7). The 6-BA products Exilis Plus and Maxcel caused minor injury in ‘Tutti Frutti’ but not in ‘Tango’. Fascination caused moderate to severe injury and reduced plant size in ‘Tutti Frutti’ while only 100 ppm was phytotoxic to ‘Tango’ three (3) days after treatment. Zonal geranium plants treated with GA₄₊₇ (50 or 100 ppm NovaGib) had higher growth index than control while no significant increase was found in ivy geraniums (Table 7). NovaGib caused no phytotoxicity on either cultivar. NovaGib also increased the peduncle length in ‘Tango’ (Table 10).

Data on number of flowers for untreated control show that both ivy and zonal geraniums in this experiment were at beginning of blooming 3 days after treatment (DAT); however, ivy geranium responded negatively to the shipping conditions while zonal geraniums were able to continue the blooming period. The 6-BA products Exilis Plus and Maxcel at 50 ppm, as well as the standard EthylBloc resulted in more open flowers over the 28 days in ‘Tutti Frutti’. In ‘Tango’, these products had more open flowers 7 DAT but the number decreased after that. This suggests that 6-BA at 50 ppm can promote flowering so plants enter blooming peak period more quickly but will also enter the final period of blooming quicker in this zonal geranium cultivar. NovaGib did not promote flowering in both ivy and zonal geraniums. Similarly, Fascination did not increase number of flowers probably due to significant phytotoxicity.

The 6-BA products Exilis Plus and Maxcel at 50 ppm prolonged the bloom period of ivy geranium ‘Tutti Frutti’ generally longer than the standard EthylBloc (Table 8). Fascination and NovaGib resulted in shorter bloom period compared to the Untreated. In the zonal geranium ‘Tango’, no product prolonged the bloom period (Table 9).

Table 7. Effect of several PGR's on Phytotoxicity, Overall Plant Quality and Growth Index of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Chen 2007.

Treatment	Ivy Geranium 'Tutti Frutti'			Zonal Geranium 'Tango'		
	Phytotoxicity Rating (1-5) ^a 3 DAT	Plant Quality Rating (1-10) 3 DAT	Growth index ^b 28 DAT	Phytotoxicity Rating (1-5) 3 DAT	Plant Quality Rating (1-10) 3 DAT	Growth index 28 DAT
Exilis Plus (6-BA) 50 ppm	0.89 cd	8.44 a	77.89 a	0.22 c	9.56 a	45.78 ab
Exilis Plus (6-BA) 100 ppm	1.33 c	7.56 cd	80.5 a	1.17 abc	8.56 bc	43.31 bc
Fascination (6-BA + GA ₄₊₇) 50 ppm	2.67 b	7.22 d	79.06 a	1.0 abc	9.44 a	46.56 ab
Fascination (6-BA + GA ₄₊₇) 100 ppm	3.56 a	5.11 e	80.94 a	1.78 a	8.33 c	40.22 c
MaxCel (6-BA) 50 ppm	0.11 ef	8.33 ab	79.28 a	0.56 c	9.33 ab	45.78 ab
MaxCel (6-BA) 100 ppm	0.56 de	7.78 bcd	86.06 a	0.67 bc	9.11 abc	43.1 bc
NovaGib (GA ₄₊₇) 50 ppm	0.11 ef	8.33 ab	78.11 a	0.78 bc	9.11 abc	46.2 ab
NovaGib (GA ₄₊₇) 100 ppm	0.44 def	8.22 ab	80.47 a	0.33 c	9.78 a	48.72 a
Untreated	0 f	8.11 abc	77.89 a	0.28 c	9.44 a	44.78 b

^a Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).^b Growth index = $\frac{[ht + (width\ 1 + width\ 2)/2]}{[ht + (width\ 1 + width\ 2)/2]}$ **Table 8. Effect of several PGR's on Number of Open Flowers of Ivy Geranium (*Pelargonium peltatum*), 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Chen 2007.**

Treatment	Number of Open Flowers ^z							
	Ivy Geranium 'Tutti Frutti'				Zonal Geranium 'Tango'			
	3 DAT	14 DAT	22 DAT	28 DAT	3 DAT	14 DAT	22 DAT	28 DAT
Exilis Plus (6-BA) 50 ppm	1.0 a	2.9 ab	5.0 ab	3.3 ab	2.8 a	8.4 ab	4.9 c	2.1 bcde
Exilis Plus (6-BA) 100 ppm	3.7 a	1.6 cd	3.3 b	4.7 a	2.2 a	5.1 bc	5.8 c	4.1 bcd
Fascination (6-BA + GA ₄₊₇) 50 ppm	3.0 a	1.4 cd	0 d	0.1 d	0.4 a	3.4 c	0.6 d	0.7 de
Fascination (6-BA + GA ₄₊₇) 100 ppm	2.6 a	0.1 e	0 d	0 d	1.2 a	3.2 c	1.0 d	0.2 e
MaxCel (6-BA) 50 ppm	2.4 a	3.2 a	5.9 a	4.6 a	3.3 a	10.4 a	6.6 bc	3.1 bcde
MaxCel (6-BA) 100 ppm	1.7 a	0.3 de	1.3 cd	1.1 cd	0.7 a	3.4 c	5.6 c	4.7 bc
NovaGib (GA ₄₊₇) 50 ppm	1.1 a	1.0 cde	0 d	0 d	1.4 a	6.4 bc	3.1 cd	2.0 cde
NovaGib (GA ₄₊₇) 100 ppm	2.9 a	0.1 e	0 d	0 d	1.8 a	8.2 ab	0.7 d	0.3 e
Ethylbloc (1-MCP 1ppm)	4.1 a	3.7 a	3.1 bc	2.3 bc	4.3 a	8.3 ab	11.2 a	5.6 b
Untreated	2.8 a	1.7 bc	0.9 d	0.9 cd	2.0 a	5.6 bc	10.1 ab	10.3 a

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).

Table 9 . Effect of several PGR's on Number of Peduncles with Open and Spent Flowers of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti', Chen 2007.

Treatment	Number of Peduncles ^z						
	3 DAT	14 DAT		22 DAT		28DAT	
	Total	With Open Flowers	With Spent Flowers	With Open Flowers	With Spent Flowers	With Open Flowers	With Spent Flowers
Exilis Plus (6-BA) 50 ppm	3.22 a	4.11 ab	0.33 cd	2.78 a	3.33 de	2.0 bc	4.33 def
Exilis Plus (6-BA) 100 ppm	4.11 a	3.78 ab	1.22 b	2.33 ab	3.0 e	2.56 ab	3.44 f
Fascination (6-BA + GA ₄₊₇) 50 ppm	3.89 a	3.67 b	0.33 cd	0.11 c	5.0 bc	0.11 e	6.11 abc
Fascination (6-BA + GA ₄₊₇) 100 ppm	3.56 a	1.67 c	2.56 a	0 c	4.67 bcd	0 e	5.11 bcde
MaxCel (6-BA) 50 ppm	4.11 a	4.67 ab	1.11 bc	3.11 a	3.44 de	3.56 a	4.78 bcdef
MaxCel (6-BA) 100 ppm	3.67 a	3.89 ab	0.67 bcd	1.89 b	3.33 de	1.33 cd	4.67 cdef
NovaGib (GA ₄₊₇) 50 ppm	3.89 a	4.67 ab	0.22 d	0 c	5.78 ab	0 e	6.33 ab
NovaGib (GA ₄₊₇) 100 ppm	4.56 a	5.0 a	0.56 bcd	0 c	6.56 a	0 e	7.0 a
Ethylbloc (1-MCP 1ppm)	4.22 a	4.67 ab	1.0 bcd	1.56 b	4.56 bcd	1.44 cd	5.44 abcd
Untreated	4.11 a	1.67 c	2.78 a	0.67 c	3.89 cde	0.89 de	3.78 ef

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).

Table 10. Effect of several PGR's on Number of Peduncles with Open and Spent Flowers of Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Chen 2007.

Treatment	Number of Peduncles ^z				
	7 DAT	23 DAT		28 DAT	
	Total	With Open Flowers	With Spent Flowers	With Open Flowers	With Spent Flowers
Exilis Plus (6-BA) 50 ppm	1.56 a	1.33 bc	1.11 cd	0.78 bcde	2.0 d
Exilis Plus (6-BA) 100 ppm	2.22 a	1.89 ab	1.33 cd	1.56 ab	2.33 bcd
Fascination (6-BA + GA ₄₊₇) 50 ppm	2.67 a	0.78 cd	1.78 bc	0.33 de	2.33 bcd
Fascination (6-BA + GA ₄₊₇) 100 ppm	2.89 a	0.56 d	3.0 a	0.11 e	3.44 a
MaxCel (6-BA) 50 ppm	2.0 a	2.0 ab	0.78 d	1.11 bcd	2.11 cd
MaxCel (6-BA) 100 ppm	2.11 a	1.89 ab	1.0 cd	1.11 bcd	2.11 cd
NovaGib (GA ₄₊₇) 50 ppm	2.33 a	0.89 cd	2.44 ab	0.56 cde	3.11 abc
NovaGib (GA ₄₊₇) 100 ppm	2.56 a	0.44 d	2.44 ab	0.11 e	3.33 ab
Ethylbloc (1-MCP 1ppm)	2.0 a	2.0 ab	1.56 bcd	1.22 bc	2.56 abcd
Untreated	2.56 a	2.44 a	1.22 cd	2.11 a	2.33 bcd

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).

Table 11. Effect of several PGR's on Peduncle Length of Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Chen 2007.

Treatment	Peduncle Length (cm) ^z		
	Peduncle No. 1	Peduncle No. 2	Peduncle No. 3
Exilis Plus (6-BA) 50 ppm	18.72 a	11.81 e	10.75 cd
Exilis Plus (6-BA) 100 ppm	16.50 a	12.56 de	10.86 cd
Fascination (6-BA + GA ₄₊₇) 50 ppm	17.67 a	14.71 bcde	15.3 ab
Fascination (6-BA + GA ₄₊₇) 100 ppm	19.39 a	17.78 ab	15.86 a
MaxCel (6-BA) 50 ppm	18.11 a	13.19 cde	10.0 d
MaxCel (6-BA) 100 ppm	18.67 a	13.44 cde	10.1 d
NovaGib (GA ₄₊₇) 50 ppm	18.61 a	16.13 abc	13.67 abc
NovaGib (GA ₄₊₇) 100 ppm	20.33 a	18.75 a	16.5 a
Ethylbloc (1-MCP 1ppm)	18.67 a	12.88 de	10.86 cd
Untreated	19.56 a	15.0 bcd	12.75 bcd

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).

Miller 2007

In 2007, Miller conducted an experiment to determine effect of five products on shelf life of ivy geranium 'Tutti Frutti' and zonal geranium 'Tango'. Fascination, Maxcel and Provide were applied at 100 ppm and the standard EthylBloc at 1 ppm. Plants were moved to a room maintained at 20 °C to simulate transport for 3 days in darkness. Shelf life was evaluated with flower counts, stem length, leaf yellowing (chlorosis), visual quality on a scale of 0 to 10 (with 0 being unsalable and 10 being highly attractive), and postproduction longevity (number of days after simulated shipping until five or fewer healthy florets remained on the plant). Phytotoxicity was also observed.

Maxcel caused bleached spots or area on open florets before simulated transport and Fascination caused necrotic areas on the receptacle and leaves after simulated transport. Maxcel was the only treatment that caused significantly higher abscission rate in 'Tutti Frutti' (Table 12); this resulted from phytotoxicity that appeared before simulated transport. No significant difference in abscission rate was observed in 'Tango'. All treatments have the same number of flowers before simulated transport in both cultivars (Table 13). In 'Tutti Frutti', Fascination increased floret number by 17 days, increasing postproduction longevity (Table 13). In 'Tango', both Fascination and Provide increased floret number from 7 days (Table 13), resulting in greater enhancement of postproduction longevity (Table 14). Fascination and Provide also increased plant height (Table 15) and inflorescence diameter (data not shown). Maxcel and EthylBloc did not increase flower numbers or longevity in both cultivars. It should be noted that plants were not specifically ethylene-stressed after the EthylBloc application. (In the absence of ethylene EthylBloc often shows no effect).

In 'Tango', florets that developed during simulated transport after treatment with distilled water, Maxcel or EthylBloc showed stunted growth while Fascination induced Kalanchoe-looking unusual small size of florets. Provide stimulated growth of florets that were open during and after simulated transport, increasing floret size, while florets open long after simulated transport displayed Kalanchoe-looking small florets as was observed in florets sprayed with Fascination.

Fascination and Provide greatly reduced leaf yellowing in both cultivars, resulting in higher visual quality compared to other treatments (Table 14). These results suggest that GA₄₊₇ enhances postproduction quality in geraniums. Further research will be needed to determine concentrations and application details for maximum effectiveness.

Table 12. Effect of several PGR's on Floret Abscission of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Miller 2007.

Treatment	Abscission Rate (%) During Simulated Shipping ^z	
	'Tutti Frutti'	'Tango'
Fascination (6-BA + GA ₄₊₇) 100 ppm	17.1 ab	45.7 a
MaxCel (6-BA) 100 ppm	30.5 b	58.6 a
ProVide (GA ₄₊₇) 100 ppm	10.6 ab	36.7 a
EthylBloc (1-MCP) 1 ppm	9.7 a	34.2 a
Untreated	3.1 a	46.4 a

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, Tukey's test).

Table 13. Effect of several PGR's on Number of Florets produced by Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango' before and after simulated shipping, Miller 2007.

Cultivar	Treatment	Number of Flowers Before and After Simulated Retail Outdoor Display									
		-5	-4	-3	0	3	7	10	14	17	21
Tutti Frutti	Control	3.3 a	5.1 a	7.1 a	14.9 a	23.4 a	25.8 a	28.1 a	22.0 a	8.4 a	0.0 a
	Fascination (6BA + GA ₄₊₇) 100 ppm	2.9 a	3.5 a	6.5 a	14.9 a	24.6 a	26.8 a	29.0 a	24.4 a	19.1 b	5.1 b
	Provide (GA4+7) 100 ppm	2.0 a	4.9 a	6.9 a	18.1 a	24.0 a	28.9 a	32.0 a	23.4 a	11.9 ab	1.9 ab
	Maxcel (BA) 100 ppm	3.9 a	5.0 a	9.5 a	16.3 a	24.4 a	26.3 a	28.1 a	21.6 a	14.4 ab	4.0 ab
	Ethylbloc (1-MCP) 1ppm	2.8 a	4.8 a	7.8 a	15.5 a	25.0 a	26.5 a	28.0 a	19.6 a	6.9 a	0.6 a
Tango	Control	3.0 a	4.5 a	6.6 a	16.0 a	16.4 a	10.4 a	4.4 a	2.8 a	1.0 a	0.0 a
	Fascination (6BA + GA ₄₊₇) 100ppm	2.6 a	4.1 a	6.9 a	12.4 a	19.4 a	30.1 b	40.0 b	36.3 b	27.5 b	21.9 b
	Provide (GA4+7) 100 ppm	3.9 a	6.3 a	8.9 a	16.5 a	22.5 a	34.5 b	46.5 b	41.9 b	31.0 b	19.9 b
	Maxcel (BA) 100 ppm	2.4 a	4.3 a	6.8 a	13.8 a	20.4 a	13.4 a	6.4 a	3.6 a	0.3 a	0.0 a
	Ethylbloc (1-MCP) 1 ppm	2.9 a	4.5 a	7.6 a	14.8 a	21.4 a	12.1 a	2.9 a	1.3 a	0.0 a	0.0 a

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, Tukey's test).

Plants treated at Day -5 followed by simulated transport at Day -3 and placed in a simulated retail outdoor display facility at Day 0 for postproduction evaluation for 21 days.

Table 14. Effect of several PGR's on Leaf Yellowing and Visual Quality of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango' in a simulated retail outdoor display facility, Miller 2007.

Cultivar	Treatment	Leaf Yellowing (%)			Visual Quality				
		3	7	14	0	3	7	10	17
Tutti Frutti	Control	18.8 c	32.5c	33.8 c	5.6 a	8.8 a	7.0 a	1.3 a	1.8 a
	Fascination (6BA + GA ₄₊₇) 100 ppm	3.8 a	3.1 a	4.4 a	5.4 a	9.1 bc	9.1 bc	4.8 b	4.1 b
	Provide (GA4+7) 100 ppm	3.1 a	3.1 a	2.5 a	6.1 a	9.6 a	9.9 c	5.9 b	2.6 ab
	Maxcel (BA) 100 ppm	17.5 b	18.8	20.0 b	5.8 a	8.3 a	8.4 b	0.9 a	2.5 ab
	Ethylbloc (1-MCP) 1 ppm	25.0 c	33.8 c	33.8 c	5.6 a	8.9 a	6.1 a	0.3 a	0.9 a
Tango	Control	50.6 d	50.6 c	52.5 c	5.3 a	1.1 a	0.4 a	1.0 a	0.3 a
	Fascination (6BA + GA ₄₊₇)100 ppm	5.6 a	15.6 a	22.5 a	4.9 a	5.6 cd	5.6 b	4.8 b	1.9 b
	Provide (GA4+7) 100 ppm	1.9 a	10.0 a	17.5 a	5.3 a	7.3 d	6.9 b	5.9 b	1.9 b
	Maxcel (BA) 100 ppm	27.5 b	40.6 bc	43.1 bc	4.4 a	4.5 c	1.4 a	0.9 a	0.0 a
	Ethylbloc (1-MCP) 1 ppm	38.8 c	37.5 b	37.5 b	4.8 a	2.5 ab	0.8 a	0.3 a	0.0 a

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, Tukey's test).

Table 15. Effect of several PGR's on Plant Height and Postproduction Longevity of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango' in a simulated retail outdoor display facility, Miller 2007.

Treatment	Tutti Frutti		Tango	
	Plant Height (cm) ^z at Day 10	Postproduction Longevity (days)	Plant Height (cm) at Day 10	Postproduction Longevity (days)
Fascination (6-BA + GA ₄₊₇) 100 ppm	24.2 b	21.3 b	28.8 b	22.9 b
MaxCel (6-BA) 100 ppm	21.0 b	20.6 ab	21.2 a	10.9 a
ProVide (GA ₄₊₇) 100 ppm	21.6 ab	19.8 ab	28.3 b	22.0 b
EthylBloc (1-MCP) 1 ppm	19.6 a	19.3 ab	22.7 a	9.1 a
Untreated	20.9 ab	18.5 a	24.0 a	9.9 a

^z Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, Tukey's test).

Plants treated at Day -5 followed by simulated transport at Day -3 and placed in a simulated retail outdoor display facility at Day 0 for postproduction evaluation for 21 days.

Pemberton 2007

In 2007, Pemberton conducted an experiment to determine effect of four products on shelf life of ivy geranium 'Tutti Frutti' and zonal geranium 'Tango'. Fascination, Maxcel and Provide were applied at 100 ppm and the standard EthylBloc at 1 ppm. Plants were subjected to simulated shipping in the dark for 48 hours. Plant performance was assessed with a rating scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering. Number of flowers, peduncle length, plant height and width were recorded and phytotoxicity symptoms were rated on a scale of 1 to 10 with 1 being none and 10 being extreme burning of leaves and flowers.

In 'Tutti Frutti', Provide improved performance rating at 11 DAT, though the number of flowers were unaffected (

Table 17). Fascination resulted in lower performance rating at 11 to 25 DAT due to high phytotoxicity (mainly leaf burning); no other treatment caused phytotoxicity. The phytotoxicity was presumably due to the 6-BA in the Fascination product as Provide did not cause any symptoms, but no phytotoxicity was seen on MaxCel (also containing 6-BA) treated plants. In the 2006 study, moderate toxicity was seen on an ivy leaf variety 'Freestyle Pink' due to MaxCel application (Table 4). Flower number was unaffected by treatments until the last evaluation date when plants treated with Fascination, Provide, and EthylBloc had fewer flowers than the control. At 25 DAT, plants treated with the products containing GA₄₊₇ (Provide and Fascination) had longer peduncles than the control. Also at this time, plants treated with Fascination had a smaller plant volume than the control, while other treatments are not different.

In 'Tango', products containing GA₄₊₇ (Provide and Fascination) improved performance rating at 10 DAT and increased the number of flowers at 10 and 17 DAT (Table 16). MaxCel caused significant phytotoxicity (very slight leaf burning), but performance ratings were unaffected. Fascination, Provide, and MaxCel resulted in fewer spent inflorescences than EthylBloc and untreated control at 10 DAT, but the effect was not seen one week later. At 17 and 24 DAT, all Fascination and Provide treated plants were observed to have new flowers that were opening smaller than flowers at the start of the study. Provide increased peduncle length and plant volume

at 24 DAT. Also at 24 DAT, EthylBloc and untreated plants were observed to have some lower leaf yellowing while plants in other treatments did not.

Products containing GA₄₊₇ may be useful for increasing flowering during the postharvest period as long as plants don't remain on the shelf for an extended period. The phytotoxicity of Fascination on 'Tutti Frutti' plants was surprising, but cultivar selection will evidently be important in determining the success of GA product use. The use of products containing 6-BA could be a problem for ivy leaf and seed grown types based on the 2006 and 2007 results. These effects could also depend on the marketing environment light levels and the use of growth retardants prior to harvest.

Table 16. Effect of several PGR's on the Postharvest Performance of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti', Pemberton 2007.

Treatment	Postharvest Performance by Evaluation Date				
	6/1/07 ^a 1 DAT	6/4/07 4 DAT	6/11/07 11 DAT	6/18/07 18 DAT	6/25/07 25 DAT
Performance Rating^b					
Fascination (6-BA + GA ₄₊₇) 100 ppm	7.3	6.4	5.6 c	5.0 b	5.1 c
MaxCel (6-BA) 100 ppm	7.4	7.6	8.0 ab	7.6 a	6.8 a
ProVide (GA ₄₊₇) 100 ppm	7.5	7.8	8.4 a	7.3 a	5.8 bc
EthylBloc (1-MCP) 1 ppm	7.5	7.6	7.9 ab	6.8 a	6.5 ab
Untreated	7.5	7.5	7.5 b	7.1 a	6.5 ab
ANOVA	NS	NS	**	**	**
Number of Inflorescences					
Fascination (6-BA + GA ₄₊₇) 100 ppm	2.6	3.6	7.6	4.1	0.0 c
MaxCel (6-BA) 100 ppm	2.4	3.3	6.8	5.4	5.3 a
ProVide (GA ₄₊₇) 100 ppm	2.0	3.4	7.8	4.6	0.3 c
EthylBloc (1-MCP) 1 ppm	2.5	4.0	6.9	3.4	2.6 b
Untreated	2.9	2.9	6.9	6.1	5.4 a
ANOVA	NS	NS	NS	NS	**
Phytotoxicity					
Fascination (6-BA + GA ₄₊₇) 100 ppm		3.9 a	4.9 a	4.0 a	
MaxCel (6-BA) 100 ppm		1.0 b	1.0 b	1.0 b	
ProVide (GA ₄₊₇) 100 ppm		1.0 b	1.0 b	1.0 b	
EthylBloc (1-MCP) 1 ppm		1.0 b	1.0 b	1.0 b	
Untreated		1.0 b	1.0 b	1.0 b	
ANOVA		**	**	**	

^a All treatments applied 5/31/07.

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 17. Effect of several PGR's on the Postharvest Performance of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti', Pemberton 2007.

Treatment	Peduncle Length (cm)	Final Volume (cm ³)	Change in Volume (cm ³)
	1 DAT	4 DAT	11 DAT
Fascination (6-BA + GA ₄₊₇) 100 ppm	14.9 ab	44643 c	18049 c
MaxCel (6-BA) 100 ppm	13.4 bc	53479 bc	25704 bc
ProVide (GA ₄₊₇) 100 ppm	17.3 a	82973 a	60368 a
EthylBloc (1-MCP) 1 ppm	12.5 c	67929 ab	34090 bc
Untreated	12.3 c	73312 ab	44445 ab
ANOVA	**	**	**

Table 18. Effect of several PGR's on the Postharvest Performance of Zonal Geranium (*Pelargonium x hortorum*.) 'Tango, Pemberton 2007.

Treatment	Evaluation Date				
	1 DAT	3 DAT	10 DAT	17 DAT	24 DAT
Performance Rating ^a					
Fascination (6-BA + GA ₄₊₇) 100 ppm	8.4	8.0	8.5 a	7.0	6.0
MaxCel (6-BA) 100 ppm	7.9	7.3	7.6 b	7.0	6.5
ProVide (GA ₄₊₇) 100 ppm	7.9	7.4	8.4 a	7.4	6.0
EthylBloc (1-MCP) 1 ppm	7.9	7.1	7.3 b	7.1	5.9
Untreated	8.3	7.6	7.1 b	6.4	6.4
ANOVA	NS	NS	**	NS	NS
Number of Inflorescences					
Fascination (6-BA + GA ₄₊₇) 100 ppm	3.8	4.0	5.9 a	4.8 ab	1.3
MaxCel (6-BA) 100 ppm	3.1	3.4	4.8 ab	3.0 cd	1.1
ProVide (GA ₄₊₇) 100 ppm	2.6	3.0	5.6 a	5.4 a	1.0
EthylBloc (1-MCP) 1 ppm	2.8	3.3	4.4 ab	3.8 bc	1.5
Untreated	3.4	3.5	4.0 b	1.9 d	1.8
ANOVA	NS	NS	10%	**	NS
Phytotoxicity					
Fascination (6-BA + GA ₄₊₇) 100 ppm	1.0 b	1.0 b			
MaxCel (6-BA) 100 ppm	2.0 a	1.8 a			
ProVide (GA ₄₊₇) 100 ppm	1.0 b	1.1 b			
EthylBloc (1-MCP) 1 ppm	1.0 b	1.0 b			
Untreated	1.0 b	1.0 b			
ANOVA	**	**			
Number of Spent Inflorescences					
Fascination (6-BA + GA ₄₊₇) 100 ppm			0.8 b	3.5	
MaxCel (6-BA) 100 ppm			0.9 b	3.6	
ProVide (GA ₄₊₇) 100 ppm			0.1 c	2.4	
EthylBloc (1-MCP) 1 ppm			2.3 a	4.6	
Untreated			1.8 a	3.4	
ANOVA			**	NS	

^a Performance rating was assigned based on a scale 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 19. Effect of several PGR's on the Postharvest Performance of Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Pemberton 2007.

Treatment	Peduncle Length (cm)	Final Volume (cm ³)	Change in Volume (cm ³)
	1 DAT	3 DAT	10 DAT
Fascination (6-BA + GA ₄₊₇) 100 ppm	18.9 ab	40003 a	6219 ab
MaxCel (6-BA) 100 ppm	16.3 b	33727 ab	1039 bc
ProVide (GA ₄₊₇) 100 ppm	22.8 a	38928 ab	8344 a
EthylBloc (1-MCP) 1ppm	17.7 b	24390 c	5736 c
Untreated	18.5 b	30113 bc	1798 bc
ANOVA	*	**	*

Reid 2007

In 2007, Reid conducted an experiment to determine effect of five products on shelf life of ivy geranium. 'Tutti Frutti' and zonal geranium 'Tango'. Fascination, Maxcel and Provide were applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. The number of yellowing and dropped leaves, peduncle length and plant canopy height (excluding flowers), as well as visible damage and spray residues, were recorded.

Maxcel and Fascination caused leaf damage (a necrotic burning) in both 'Tutti Frutti' and 'Tango' (Table 20). The other treatments didn't cause any damage. Provide and TDZ greatly reduced leaf yellowing and abscission in both cultivars. In contrast, the phytotoxic effect of Maxcel and Fascination resulted in increased leaf yellowing and abscission. Argylene provided mixed results, increasing leaf yellowing in 'Tutti Frutti' and decreasing leaf abscission in 'Tango'. Figure 21 shows the cumulative leaf loss after simulated shipping. TDZ increased leaf size while Provide decreased it. Provide increased peduncle length and foliage height of 'Tango' while TDZ had no effect (Table 22).

These results show that Maxcel and Fascination cause unacceptable leaf damage and Provide causes unacceptable plant and flower stem elongation. TDZ provided the most improved plant quality and shelf life. A distinct delay in flowering was noted, suggesting that this product would need to be applied at the full color stage.

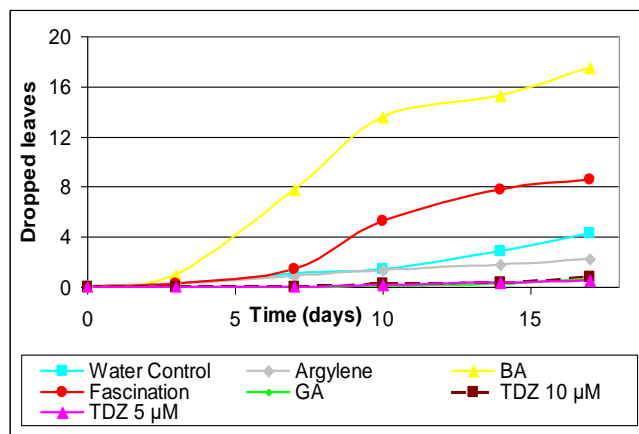
Table 20. Effect of several PGR's on Number of Damaged, Dropped and Yellow Leaves of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Reid 2007.

Treatment	Ivy Geranium 'Tutti Frutti'				Zonal Geranium 'Tango'			
	Damaged Leaves ^z 2 DAT	Yellow Leaves 12 DAT	Dropped Leaves 21 DAT	Leaf Width (cm) 19 DAT	Damaged Leaves 2 DAT	Yellow Leaves 12 DAT	Dropped Leaves 21 DAT	Leaf Width (cm) 19 DAT
Argylene XM (STS) 0.5 mM	0 a	3.9 c	10.8 b	-	0 a	3.0 b	2.2 a	-
Fascination (6-BA + GA ₄₊₇) 100ppm	17.4 c	*	*	-	3.2 b	10.2 d	8.6 c	-
MaxCel (6-BA) 100 ppm	14.4 b	*	*	-	2.9 b	6.4 c	17.5 d	-
Provide (GA ₄₊₇) 100 ppm	0 a	0.1 a	1.5 a	3.2 a	0 a	0.3 a	0.6 a	3.5 a
TDZ (Thidiazuron) 5 uM	0 a	0.3 a	3.0 a	4.8 c	0 a	0.3 a	0.8 a	6.6 c
TDZ (Thidiazuron) 10 uM	0 a	0 a	1.3 a	5.3 d	0 a	0.3 a	0.5 a	6.5 c
Untreated	0.2 a	1.9 b	11.3 b	4.3 b	0 a	2.8 b	4.3 b	5.5 b

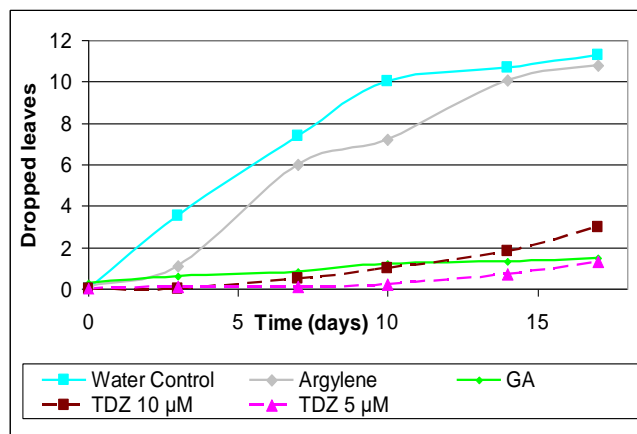
^z Means in the same column followed by the same letter are not significantly different.

* Plants lost all their leaves after the shipping simulation (2 DAT)

Figure 21 . Effect of several PGR's on Number of Dropped Leaves after simulated shipping of Ivy Geranium (*Pelargonium peltatum*) 'Tutti Frutti' and Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Reid 2007.



Tango



Tutti Frutti

Table 22. Effect of several PGR's on Peduncle Length and Foliage Height of Zonal Geranium (*Pelargonium x hortorum*) 'Tango', Reid 2007.

Treatment	Peduncle Length at 19 DAT	Foliage Height at 19 DAT
Provide (GA ₄₊₇) 100 ppm	39.3 b	25.5 b
TDZ (Thidiazuron) 5 uM	20.5 a	17.2 a
TDZ (Thidiazuron) 10 uM	20.2 a	16.5 a
Untreated	21.6 a	14.4 a

Runkle 2007

In 2007, Runkle conducted an experiment to determine effect of Configure and Fascination on shelf life of geranium 'Pinto Red'. The products were applied at 2.5, 5 and 10 ppm at visible bud or first flowering stage. Plants were subjected to 4 days of simulated shipping, placed in simulated retail setting for 2 or 4 weeks, then observed for number of chlorotic and necrotic leaves and visual quality rating on a scale of 1 (100 % damage) to 5 (no damage). Plants with visual rating of <4 would be unmarketable.

Configure applied at visible bud or first flowering stage had no effect on leaf chlorosis and visual quality rating (Table 23). Plants sprayed with Fascination had 2-15 fewer lower chlorotic leaves and had higher quality ratings after storage for 2 or 4 weeks. The timing of application did not consistently influence the effectiveness of Fascination. After 2 and 4 weeks of simulated shipping, all plants received quality ratings of <4 and were unmarketable. Studies investigating the influence of Fascination on short-term storage when plants are still marketable would be beneficial.

Table 23. Effect of PGR's on Shelf Life of Geranium (*Pelargonium* sp.) 'Pinto Red', Runkle 2007.

Storage duration (weeks)	Application timing	Treatment	Applic. rate (ppm)	Mean chlorotic and necrotic leaves (no.) \pm SE*	Mean visual rating \pm SE** (1-5)
Two (2)	At visible bud	Control	N/A	19.3 \pm 2.0	2.6 \pm 0.2
		Configure (6-BA)	2.5	15.8 \pm 2.1	2.7 \pm 0.3
			5	19.0 \pm 1.8	2.8 \pm 0.2
			10	22.6 \pm 3.4	2.8 \pm 0.2
		Fascination (6-BA + GA ₄₊₇)	2.5	14.8 \pm 1.2	3.5 \pm 0.2
			5	10.6 \pm 1.0	3.5 \pm 0.2
			10	10.0 \pm 1.6	3.7 \pm 0.2
	At first flowering	Control	NA	16.6 \pm 2.0	2.9 \pm 0.2
		Configure (6-BA)	2.5	12.4 \pm 2.0	3.2 \pm 0.3
			5	18.0 \pm 2.2	2.1 \pm 0.1
			10	20.7 \pm 1.4	2.3 \pm 0.2
		Fascination (6-BA + GA ₄₊₇)	2.5	6.6 \pm 1.0	3.5 \pm 0.2
			5	8.7 \pm 1.3	3.6 \pm 0.2
			10	7.7 \pm 0.9	3.8 \pm 0.1
Four (4)	At visible bud	Control	N/A	25.4 \pm 2.5	3.1 \pm 0.2
		Configure (6-BA)	2.5	23.2 \pm 1.7	3.1 \pm 0.2
			5	28.0 \pm 2.6	3.1 \pm 0.2
			10	31.2 \pm 2.7	2.6 \pm 0.2
		Fascination (6-BA + GA ₄₊₇)	2.5	23.3 \pm 2.1	3.0 \pm 0.2
			5	17.4 \pm 2.6	3.5 \pm 0.2
			10	19.8 \pm 2.3	3.3 \pm 0.3
	At first flowering	Control	N/A	29.1 \pm 2.9	2.7 \pm 0.3
		Configure (6-BA)	2.5	23.3 \pm 2.7	3.6 \pm 0.2
			5	26.3 \pm 2.7	2.5 \pm 0.2
			10	27.5 \pm 2.2	2.7 \pm 0.2
		Fascination (6-BA + GA ₄₊₇)	2.5	14.3 \pm 1.4	3.4 \pm 0.3
			5	20.1 \pm 3.8	3.4 \pm 0.2
			10	17.1 \pm 1.8	3.6 \pm 0.2

*standard error of means of 10 replicates

**Visual ratings assigned based on the following scale: 5: No damage, 4: 1 to 24% damage, 3: 25 to 49% damage, 2: 50 to 99% damage and 1: 100% damage

Chen 2008

In the phytotoxicity experiment, 'Maverick Pink' and 'Ringo Salmon' had similar responses to PGR treatments (Table 24). GA₄₊₇ plus BA, as Fascination or Fresco, damaged young leaves and flower buds as burning and marginal browning at 50 and 100 ppm (Figure 25). BA as Exilis Plus or MaxCel at 50 and 100 ppm caused similar injuries as Fascination and Fresco with symptoms being noticeable by day 7 and less severe than the latter two products. GA as NovaGib did not

cause injury. With these results, BA or products contain BA should be applied at lower rates to avoid injury. In the efficacy study, generally, all plants had more flowers by 7 days after treatments, and number of open florets decreased to very low numbers by day 14 (Table 26 and Table 27). GA₄₊₇ plus BA as Fascination at 10 ppm and ABA drench at 125 and 250 ppm resulted in more open florets than control plants in ‘Maverick Pink’, and only ‘Ringo Salmon’ plants treated with ABA drench at 1000 ppm had more open florets than control plants. GA plus BA (Fascination) at 25 ppm and BA at 10 and 25 ppm caused leaf injuries (data not shown). In both varieties, fewer numbers of leaves exhibiting chlorosis were found in treatments containing BA than control on day 7 (

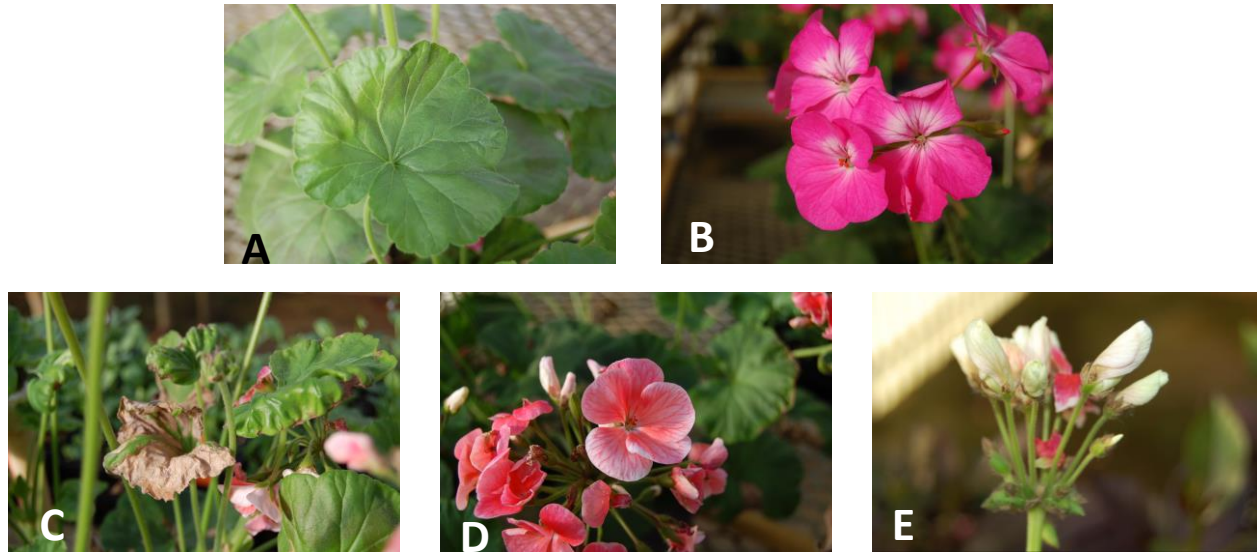
Table 28). ABA as foliar spray resulted in similar or greater numbers of chlorotic leaves. The overall plant visual quality on day 7 was rated considering phytotoxicity, leaf color, and flowering performance (

Table 28). Only ABA foliar spray at 250 resulted in higher plant quality than control plants in ‘Maverick Pink’. Based on these results, the various PGRs tested in this study provided no or little effect on improving postharvest quality of ivy geraniums.

Table 24. Phytotoxicity ratings of ‘Maverick Pink’ & ‘Ringo Salmon’ ivy geraniums treated by GA₄₊₇ + BA, BA, and GA₄ products at increasing rates, Chen, 2008

PGR	Concentration ppm	‘Maverick Pink’			‘Ringo Salmon’		
		Phytotoxicity					
		Day 3	Day 7	Day 14	Day 3	Day 7	Day 14
Fascination (GA ₄₊₇ + BA)	5	0.17 ed	0.33 e	0.33 e	0.33 d	0.50 c	0.50 f
	10	0.67 d	0.33 e	0.33 e	0.67 cd	0.33 c	0.50 f
	50	3.00 b	2.33 c	5.00 c	1.17 c	2.33 b	4.33 cd
	100	3.67 a	4.00 ab	6.33 b	3.67 a	4.00 a	7.00 ab
Fresco (GA ₄₊₇ + BA)	5	0.17 ed	0.17 e	0.17 e	0 d	0 c	0 f
	10	1.67 c	1.00 d	3.67 d	0.50 cd	0.50 c	1.67 e
	50	3.00 b	3.67 b	5.00 c	2.67 b	4.00 a	6.33 b
	100	4.00 a	4.50 a	7.33 ab	3.00 ab	3.67 a	7.00 ab
ExilisPlus (BA)	5	0 e	0 e	0 e	0 d	0 c	0.17 f
	10	0 e	0 e	0 e	0 d	0.33 c	0.33 f
	50	0 e	3.83 b	7.00 ab	0 d	2.33 b	4.67 c
	100	0 e	4.00 ab	7.67 a	0 d	2.67 b	8.00 a
Maxcel (BA)	5	0 e	0.17 e	0 e	0 d	0 c	0 f
	10	0 e	0 e	0.17 e	0.17 d	0.33 c	0.50 f
	50	0.50 ed	2.33 c	6.67 ab	0.50 cd	0.50 c	3.33 d
	100	0.50 ed	3.67 b	7.67 a	0.50 cd	2.33 b	4.33 cd
NovaGib (GA ₄)	5	0 e	0 e	0 e	0 d	0 c	0 f
	10	0 e	0 e	0 e	0 d	0 c	0 f
	50	0 e	0 e	0 e	0 d	0 c	0 f
	100	0 e	0 e	0 e	0 d	0 c	0 f
Deionized water		0 e	0.17 e	0 e	0 d	0 c	0 f
LSD _{0.05}		0.63	0.57	1.05	0.65	0.68	1.06

Figure 25. Pictures of ivy geranium leaves and florets, Chen 2008



A and B. Maverick Pink treated with water with water (A and B, Maverick Pink)

C. Maverick Pink leaves exhibiting burns with 100 ppm GA₄₊₇ plus BA (Fascination) on day 7 after treatment

D. Ringo Salmon florets exhibiting faded color with 100 ppm GA₄₊₇ plus BA (Fascination) on day 7 after treatment

E. Florets of Maverick Pink showing burns, faded color, and failure to open at day 21 after treatment

Table 26. Number of open florets on ‘Maverick Pink’ ivy geranium plants after a single application of GA₄₊₇ plus BA, BA, and GA₄ products at increasing rates, Chen, 2008

Treatment	Rate ppm	‘Maverick Pink’			
		Day 3	Day 7	Day 14	Day 21
Fascination (GA ₄₊₇ + BA)	10	6.5	12.5 a	1.3 abcde	3.2 a
	25	8.2	5.2 de	2.2 ab	2.2 abc
ExilisPlus (BA)	10	5.2	7.5 bcde	2.5 a	2.5 ab
	25	5.3	6.2 cde	0.8 bcde	0.5 cd
NovaGib (GA ₄)	10	7.2	8.8 abcd	1.3 bcde	1.0 bcd
	25	4.7	4.5 e	0.2 e	1.0 bcd
	50	5.0	6.0 cde	0.8 bcde	1.2 bcd
	100	5.2	3.8 e	0.3 de	0 d
ABA Drench	125	11	9.7 abc	2.0 abc	2.3 abc
	250	5.3	10.5 ab	1.6 abcd	2.2 abc
	500	6.8	9.0 abcd	1.7 abcd	0.2 d
ABA Foliar	250	2.5	4.7 e	0.5 de	0 d
	500	7.2	3.7 e	0.7 cde	0 d
	1000	4.2	5.5 de	0.2 e	0 d
Deionized water		4.2	6.7 cde	1.0 bcde	2.2 abc
LSD _{0.05}		NS*	4.0	5.9	2.0

*No significant difference was found between treatments.

Table 27. Number of open florets on ‘Ringo Salmon’ ivy geranium plants after a single application of GA₄₊₇ plus BA, BA, and GA₄ products at increasing rates, Chen, 2008

Treatment	Rate ppm	‘Ringo Salmon’			
		Day 3	Day 7	Day 14	Day 21
Fascination (GA ₄₊₇ + BA)	10	4.2	7.5 abc	1.2 bcdef	1.2 bcd
	25	7.3	5.6 bcd	0.7 def	1.3 bcd
Exilis Plus (BA)	10	7.3	7.0 bc	2.5 abcde	2.5 ab
	25	4.0	6.0 bcd	0.2 f	0 d
NovaGib (GA ₄)	10	6.0	6.3 bcd	0.5 f	0.7 cd
	25	7.3	6.2 bcd	1.5 bcdef	0 d
	50	5.7	2.5 d	1.0 cdef	0.2 d
	100	7.8	7.0 bc	0.8 cdef	1.8 bc
ABA Drench	125	4.8	6.7 bc	3.2 ab	0.4 cd
	250	5.3	7.6 abc	1.0 cdef	3.5 a
	500	7.6	11.0 a	2.3 abcde	0.3 cd
ABA Foliar	250	4.8	5.2 cd	3.2 ab	1.3 bcd
	500	3.8	9.3 ab	2.8 abc	1.2 bcd
	1000	5.2	7.7 abc	2.7 abcd	0.2 d
Deionized water		4.8	6.7 bc	3.3 a	0.5 cd
LSD _{0.05}		NS	5.9	5.9	1.6

Table 28. Number of chlorotic leaves in ‘Maverick Pink’ and ‘Ringo Salmon’ ivy geraniums after an application of PGRs at increasing rates, Chen, 2008

Treatment	Rate ppm	‘Maverick Pink’		‘Ringo Salmon’	
		Chlorotic Leaves (num.)	Visual Quality*	Chlorotic Leaves (num.)	Visual Quality
Fascination (GA ₄₊₇ + BA)	10	4.8 efg	7.9 ab	4.3 fgh	6.3 bcd
	25	4.3 fg	5.0 ef	3.2 h	5.0 de
ExilisPlus (BA)	10	3.8 g	6.4 cd	4.2 gh	5.6 cde
	25	2.7 g	5.6 de	4.5 fgh	5.3 cde
NovaGib (GA ₄)	10	6.3 def	7.3 abc	7.7 ef	7.0 b
	25	7.2 de	4.3 fg	8.0 e	5.2 de
	50	5.0 efg	5.0 ef	9.8 cde	4.7 e
	100	6.3 def	3.5 g	6.8 efg	2.8 f
ABA Drench	125	8.0 cd	7.8 ab	8.8 de	6.3 bcd
	250	9.7 bc	5.8 de	11.4 bcd	6.6 bc
	500	9.7 bc	5.8 de	15.3 a	5.7 bcde
ABA Foliar	250	8.2 cd	8.4 a	8.2 de	8.8 a
	500	12.8 a	5.0 ef	13.7 ab	4.8 e
	1000	11.3 ab	4.7 efg	12.7 abc	6.0 bcde
Deionized water		8.2 cd	7.1 bc	9.7 cde	8.4 a
LSD _{0.05}		2.4	1.2	5.9	5.9

*Plant visual quality was rated by a scale of 1 to 10 where 1 to 4 being unsalable, 5 to 8 being marketable at a discounted price, and 9 to 10 being highly attractive and marketable at a premium price.

Pemberton 2008

The geranium cultivars used in Pemberton's research included Maverick Pink (seed grown type) and Ringo Salmon 2000 (vegetative zonal type). For Maverick Pink, Dropp improved performance ratings over the control for the last two evaluation dates (November 20 and 28), though the number of flowers were unaffected (Table 29). Plants treated with Provide behaved similar to the controls throughout the study. ABA treated plants exhibited slightly reduced performance ratings than the control on the first two evaluation dates, but the difference was small. These plants had a small number of yellowing leaves in the lower to mid canopy that resulted in a slightly greater phytotoxicity rating than the control that would not likely affect retailability. Fascination and MaxCel both resulted in lower performance ratings than the control for the first three evaluation dates, and plants were doing so poorly that they were not evaluated for the last two dates. The major reason for this was leaf burn, though the flowers were also affected, which resulted in phytotoxicity ratings much higher than the control. These two products also reduced flower number by the third evaluation date. Plants treated with Dropp had fewer spent inflorescences than the control indicating fewer overall number of flowers during the study, but the flowers were rated closer to the rating of 4 (normal flowers) than the control which had very few flowers that hadn't already senesced. This indicates that flowers on the Dropp treated plants stayed fresher longer than the controls.

For Ringo Salmon 2000, Dropp had no effect on the plants (Table 31). Performance of Provide treated plants was significantly lower than the control on some evaluation dates, but the difference was very small. ABA treatment had results similar to that on Maverick Pink, but performance was only affected on the first evaluation date. ABA caused a very slight spotting on some of the petals in addition to the minor leaf yellowing symptoms. Fascination and MaxCel produced the same phytotoxic symptoms and reduced performance ratings that were seen on Maverick Pink plants. Dropp again resulted in fewer spent inflorescences than the control. Provide had more flowers that were normal or aborted than the control. This may have been due to the low light levels during the evaluation period.

Provide has been beneficial in the 2006 and 2007 studies, but not in this study. Perhaps testing higher concentrations would be beneficial, especially in a retail environment with higher light levels than used in the present study. Dropp had a beneficial effect on Maverick Pink, but not on Ringo Salmon 2000. Dropp contains thidiazuron, a cytokinin, which may be beneficial to geraniums at higher concentrations than the rate used in this study. MaxCel and Fascination both contain BA, also a cytokinin, which appears to be detrimental to geraniums. However, it is not known if it is the BA or something in the formulation.

Table 29. The effect of growth regulators on the postharvest performance of geranium ‘Maverick Pink’. Pemberton, 2008.

Treatment	Evaluation Date				
	3 November	5 November	12 November	20 November	28 November
<i>Performance Rating</i>					
ABA 100 ppm	8.8 b	8.7 c	9 a	8.2 b	6.8 b
Fascination 100 ppm	5.2 c	4.2 d	3.5 b	NE ^a	NE
MaxCel 100 ppm	5.0 c	3.7 e	2.5 c	NE	NE
ProVide 100 ppm	9.8 a	9.2 bc	9.2 a	9 ab	7.2 ab
Dropp1 ppm	9.8 a	10 a	9.8 a	9.5 a	8 a
Untreated	9.5 a	9.5 ab	9.2 a	8.3 b	6.3 b
ANOVA	**	**	**	*	*
<i>Number of Inflorescences</i>					
ABA 100 ppm	1.5	2.3	2.8 a	2.7	1.2
Fascination 100 ppm	1.5	1.5	1.2 cd	NE	NE
MaxCel 100 ppm	1.7	1.5	0.7 d	NE	NE
ProVide 100 ppm	1.3	1.5	2.2 ab	2.4	1.7
Dropp 1 ppm	1.2	1.2	1.8 bc	2.5	1.6
Untreated	1.5	1.8	2.7 ab	2.5	0.2
ANOVA	NS	NS	**	NS	NS

^aNE = Plants no longer being evaluated due to poor performance.

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 30. The effect of growth regulators on the postharvest performance of geranium ‘Maverick Pink’. Pemberton, 2008.

Treatment	Phytotoxicity	Plant Height (cm)	No. of Spent Inflorescences	Final Flower Quality Rating
	3 November	5 November	28 November	28 November
ABA 100 ppm	1.8 c	28.0	3.8 a	2.5 ab
Fascination 100 ppm	6.0 a	29.3	NE	NE
MaxCel 100 ppm	5.2 b	26.2	NE	NE
ProVide 100 ppm	1.0 d	30.3	3.6 a	2.8 ab
Dropp 1 ppm	1.0 d	26.0	2.2 b	3.6 a
Untreated	1.0 d	28.3	4.3 a	1.5 b
ANOVA	**	NS	*	*

Table 31. Effect of growth regulators on the postharvest performance of geranium ‘Ringo Salmon 2000. Pemberton, 2008.

Treatment	Evaluation Date				
	3 November	5 November	12 November	20 November	28 November
<i>Performance Rating^b</i>					
ABA 100 ppm	8.7 b	8.8 ab	9.2 ab	8.3 ab	6.7
Fascination 100 ppm	5.5 c	4.5 c	3.2 c	NE ^a	NE
MaxCel 100 ppm	5.2 c	3.3 d	2.0 d	NE	NE
ProVide 100 ppm	9.3 ab	8.2 b	8.0 b	7.3 b	6.3
Dropp 1 ppm	9.7 a	10.0 a	10.0 a	9.3 a	7.3
Untreated	9.8 a	9.7 a	9.7 a	8.7 a	6.6
ANOVA	**	**	**	*	NS
<i>Number of Inflorescences</i>					
ABA 100 ppm	1.3	2.0	3.0 a	2.0	1.5
Fascination 100 ppm	2.2	2.5	1.8 b	NE	NE
MaxCel 100 ppm	2.2	1.5	0.5 c	NE	NE
ProVide 100 ppm	1.7	2.2	2.3 ab	2.3	2.0
Dropp 1 ppm	1.5	1.8	2.2 ab	2.0	2.5
Untreated	1.7	2.0	3.0 a	2.2	1.8
ANOVA	NS	NS	**	NS	NS

^a NE = Plants no longer being evaluated due to poor performance.

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 32. Effect of growth regulators on the postharvest performance of geranium ‘Ringo Salmon 2000. Pemberton 2008

Treatment	Phytotoxicity	Plant Height (cm)	No. of Spent Inflorescences	Final Flower Quality Rating
	3 November	5 November	28 November	28 November
ABA 100 ppm	2.0 b	23.7 bc	3.2 b	3.0 a
Fascination 100 ppm	5.2 a	25.8 ab	NE	NE
MaxCel 100 ppm	4.8 a	23.3 bc	NE	NE
ProVide 100 ppm	1.5 bc	27.0 a	5.0 a	2.0 b
Dropp 1 ppm	1.0 c	22.5 c	1.8 c	3.0 a
Untreated	1.0 c	24.5 abc	4.0 ab	3.0 a
ANOVA	**	*	**	**

NE = Plants no longer being evaluated due to poor performance

Reid 2008

In 2008 Reid evaluated the effect of five plant growth regulator treatments on Ringo Salmon and Maverick Pink geranium under simulated actual shipping conditions.

Spray Residues and Phytotoxicity: Treatment with Fascination® and MaxCel® at 100 ppm caused phytotoxic lesions to develop on leaves of both geranium cultivars (Figure 33). Both of these

commercial formulations contain the cytokinin, 6-benzyladenine. No spray residues were visible on plants from the other treatments.

Figure 33. Phytotoxic symptoms of the Fascination® spray treatment on geranium ‘Ringo Salmon’ leaves after shipment from Texas to California, Reid, 2008.



Foliage Quality: Treatment with ABA and ProVide® reduced the number of yellow and dead leaves that developed on both geranium cultivars following shipment from Texas to California (Figure 34). ABA treatment was also effective in maintaining leaf appearance even when irrigation during shelf life was withheld. ‘Ringo Salmon’ plants treated with TDZ also displayed fewer senescent leaves as compared to water control plants, while ‘Maverick Pink’ plants did not benefit from TDZ. Conversely, treatment with the cytokinin-containing Fascination® or MaxCel® at 100 ppm was phytotoxic and accelerated the senescence of leaves on both geranium cultivars following transport (Figure 35). In contrast to actual shipping, ‘Ringo Salmon’ and particularly ‘Maverick Pink’ plants developed considerably fewer senescent leaves in response to simulated shipping conditions in Davis (Figure 35). Treatment with Fascination®, ProVide® and TDZ delayed leaf senescence on ‘Ringo Salmon’ plants exposed to simulated shipping (Figure 35). Spraying with ABA and MaxCel® were not effective in maintaining foliar quality on plants subjected to this particular shipping simulation.

Figure 34. Number of dead and yellow leaves on shipped geranium ‘Ringo Salmon’ (left) and ‘Maverick Pink’ (right) plants after 21 days of display life at 20°C. Reid, 2008.

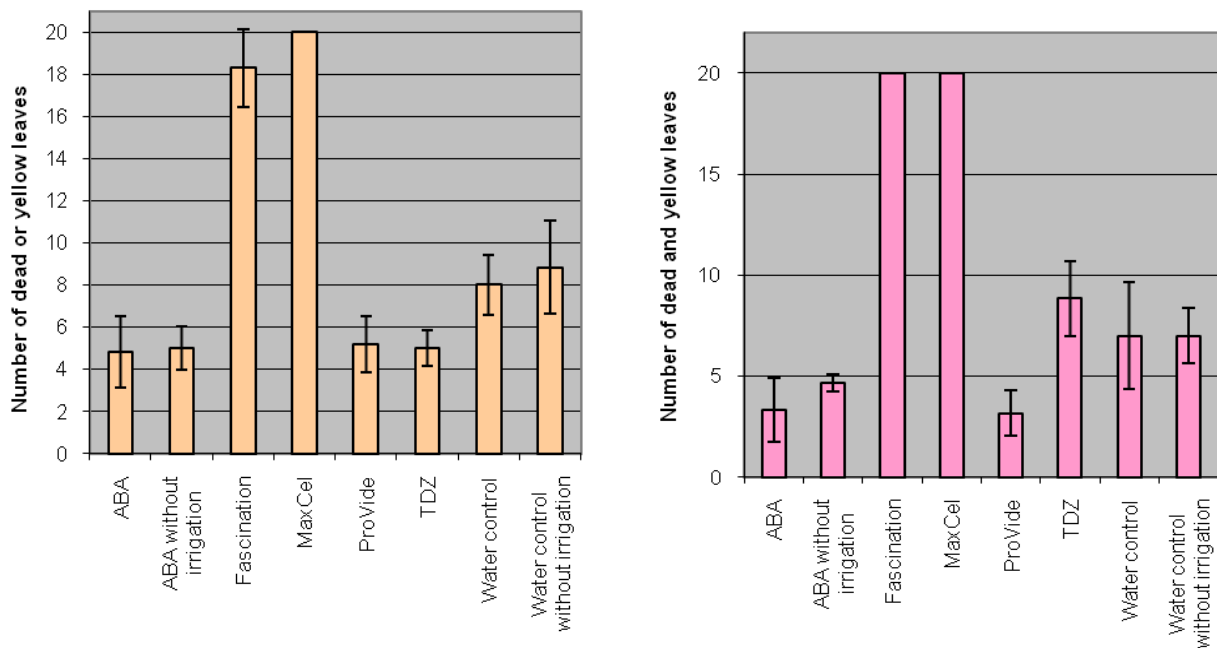
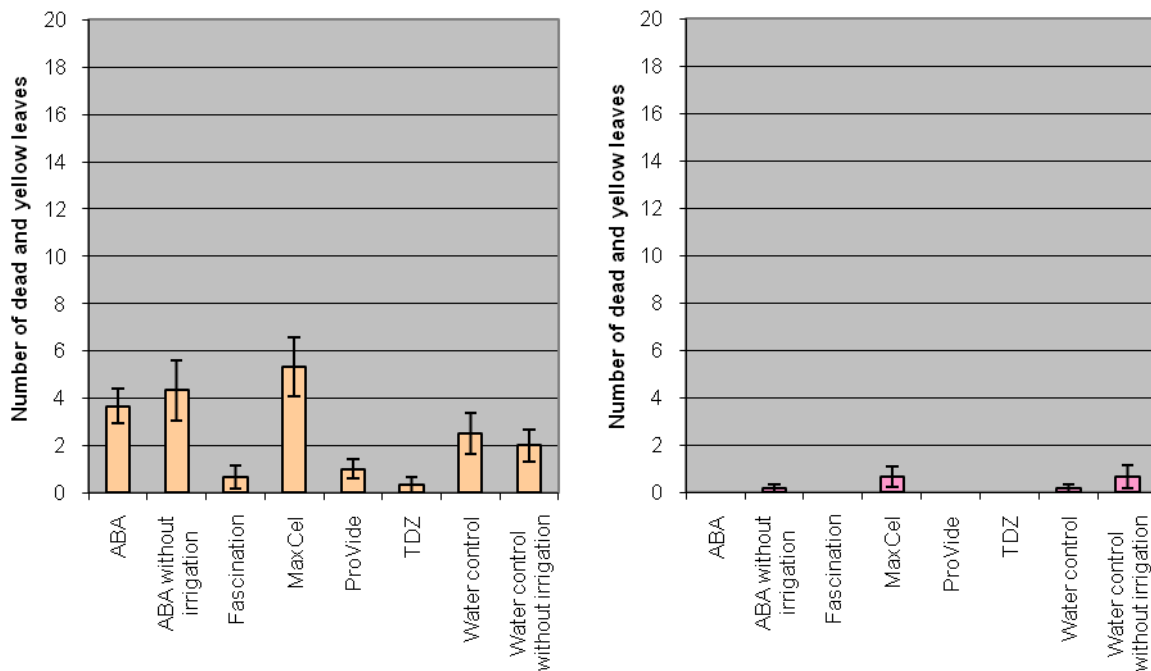


Figure 35. Number of dead and yellow leaves on geranium ‘Ringo Salmon’ (left) and ‘Maverick Pink’ (right) plants after 21 days of display life at 20°C after simulated shipping, Reid, 2008.



Flower quality: Treatment with ProVide® was most effective in extending the flowering display life of both geranium cultivars following commercial shipment (Figure 36). ‘Ringo Salmon’ plants also benefited from treatment with TDZ to exhibit a greater number of flowering spikes after 21 days of interior display than water controls. However, treatment with 100 ppm Fascination® or MaxCel®, that both contain the cytokinin, 6-benzyladenine, did not improve flower quality. These treatments actually accelerated the senescence and drop of flowers from spikes after commercial transport from Texas (Figure 37). ABA treatment and withholding irrigation during display life had no significant effect on geranium flower quality. For plants exposed to simulated shipping, there were no beneficial effects of any treatment on flower quality for either geranium cultivar (Figure 37). Indeed, treatment with ABA, Fascination®, ProVide® and TDZ slightly reduced the number of spikes that retained flowers for the entire 21-day display life for ‘Ringo Salmon’ (Figure 37). Likewise, treatment with MaxCel® reduced flower quality on ‘Maverick Pink’.

Figure 36. Number of flowering spikes on geranium ‘Ringo Salmon’ (left) and ‘Maverick Pink’ (right) plants after 21 days of display life at 20°C (shipped), Reid, 2008.

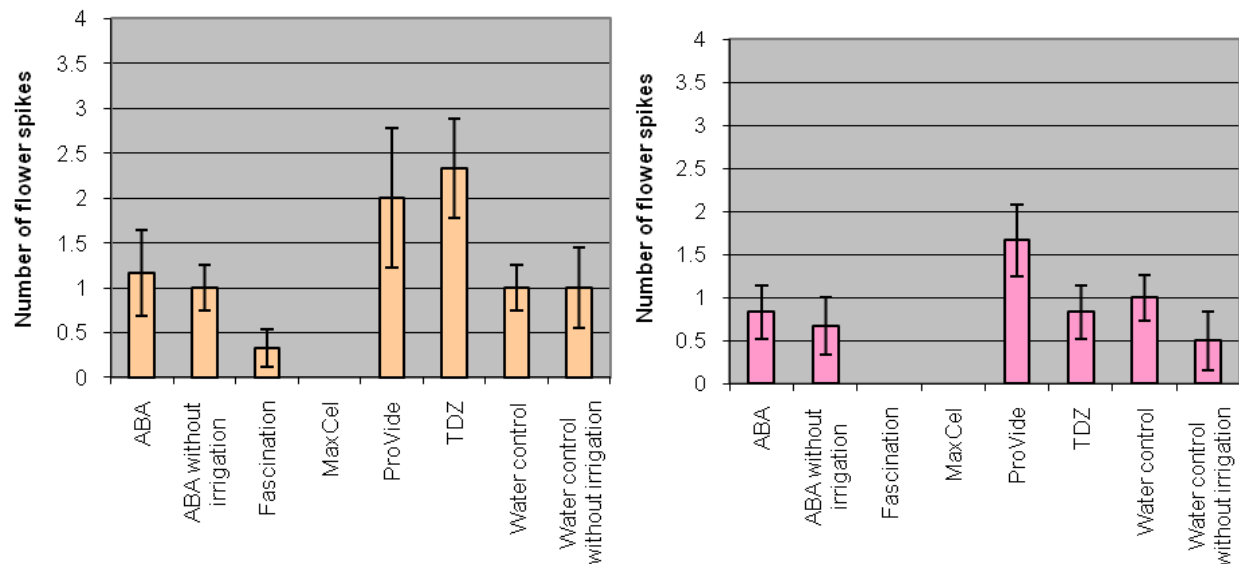
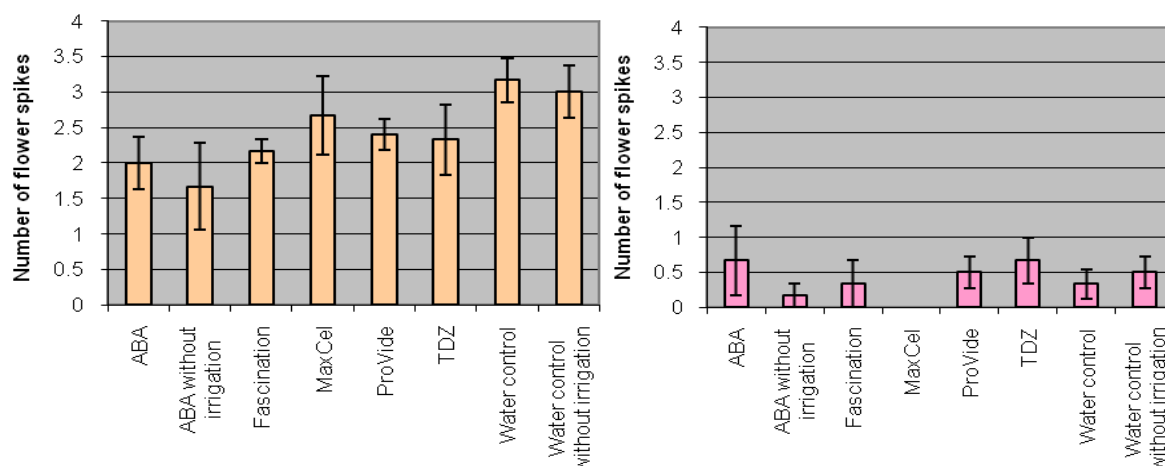
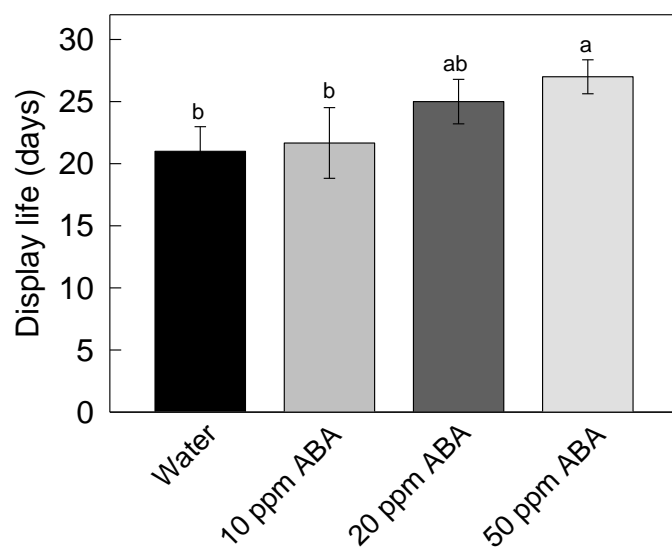


Figure 37. Number of flowering spikes on geranium ‘Ringo Salmon’ (left) and ‘Maverick Pink’ (right) plants after 21 days of display life at 20°C (Simulated Shipping), Reid, 2008.



Treatment with ABA to improve drought tolerance: To further investigate the potential of ABA treatment to improve drought tolerance, we evaluated the effects of different concentrations of ABA on plant quality. We found that spraying with just 50 ppm ABA was sufficient to extend the postproduction life of geranium ‘Ringo Salmon’ plants by 6 days at 20°C in the absence of irrigation by delaying visible wilting (Figure 38). Given that potted flowering plants can sometimes receive limited watering during retail display, pre-treatment with ABA represents an alternative strategy to safeguard against visible water stress and the associated loss in quality and sales.

Figure 38. Display life of geranium ‘Ringo Salmon’ plants at 20°C following spray treatment with different concentrations of ABA, Reid, 2008.



Display life was judged as the time (days) to visible wilting.

Data followed by different letters are significantly different.

Runkle 2008

Geranium 'Pinto Red' plants were treated with sprays or drenches of benzyl adenine (BA), gibberellic acid (GA₄₊₇), or both (BA+GA) at various concentrations to determine effects on postharvest performance. Changes to the protocol included some of the rates we used were different from that in the protocol; In addition, the temperature of dark storage was lower (15 °C) than in the protocol (20 °C). A spray adjuvant (CapSil) was added to all spray applications to ensure good foliar contact.

Applications were made either two weeks after seedlings were transplanted (2WAT) or at the visible bud stage (VB). These early applications were made with the objective of making contact with lower leaves. After application, plants received a simulated shipping treatment for 2 or 4 days at 15 °C in darkness and then were held in refrigerated growth chambers at 20 °C with a 12-hour photoperiod and 25 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (170 foot candles) of light, and relative humidity of 70%. Number of chlorotic and necrotic leaves was counted at the onset or after 1 or 2 weeks of dark storage at 15 °C.

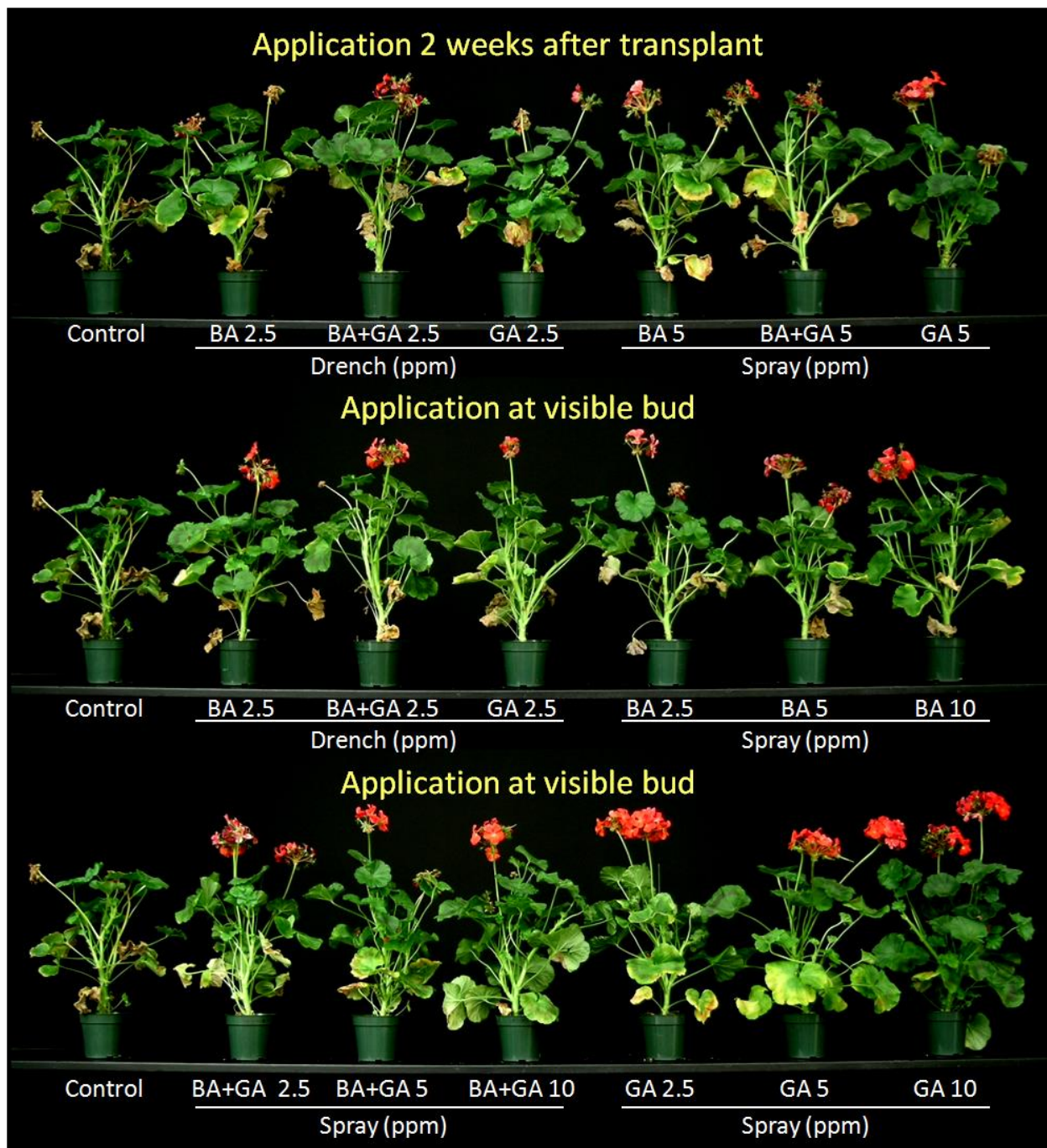
Results: Prior to shipping simulation, there was no statistically significant difference between the control and all treatments except for the BA+GA treatment at 5 ppm applied at visible bud. After 1 and 2 weeks of storage, spray treatments of GA at 2.5, 5, and 10 ppm and BA+GA at 5 and 10 ppm at visible bud reduced lower leaf chlorosis and necrosis. Spray or drench treatments of GA two weeks after transplant also decreased the number of chlorotic/necrotic leaves when measured after two weeks of storage. None of the BA treatments alone had an effect on leaf yellowing. Some of the products that contained GA negatively increased plant height.

Table 39. Effect of various plant growth regulators on postharvest storage of Geranium ‘Pinto Red’, Runkle, 2008.

Time of treatment	Application method	Treatment PG	Rate (ppm)	Number of chlorotic and necrotic leaves			Plant height (cm)
				Just before storage	After 1 week storage	After 2 weeks storage	
Untreated	-	-	-	5.4 A ²	11.8 a	16.8 a	37.8 bcd
2WAT ¹	Drench	Configure (BA)	2.5	4.8 ab	10.2 ab	14.3 a-d	36.5 d
		Fascination (BA+GA)	2.5	4.9 ab	10.6 ab	15.4 ab	36.9 cd
		Novagib (GA)	2.5	5.0 ab	9.7 a-d	13.0 b-f	38.7 a-d
	Spray	Configure (BA)	5	5.1 ab	9.9 abc	13.8 a-e	37.0 cd
		Fascination (BA+GA)	5	4.5 ab	9.5 a-d	13.6 a-e	38.6 a-d
		Novagib (GA)	5	4.4 ab	10.3 ab	13.0 b-f	39.3 a-d
Visible Bud ¹	Drench	Configure (BA)	2.5	5.0 ab	10.7 ab	14.0 a-e	38.7 a-d
		Fascination (BA+GA)	2.5	5.2 ab	10.0 ab	13.6 a-e	40.0 a-d
		Novagib (GA)	2.5	4.7 ab	10.9 a	15.1 abc	37.8 bcd
	Spray	Configure (BA)	2.5	5.3 ab	11.0 a	15.3 abc	36.9 cd
			5	5.6 a	10.3 ab	13.3 a-e	37.1 cd
			10	5.3 a	9.9 abc	15.3 abc	38.3 a-d
		Fascination (BA+GA)	2.5	4.3 ab	9.2 a-d	13.8 a-e	39.8 a-d
			5	3.8 b	7.1 d	11.7 c-f	41.0 abc
			10	4.4 ab	7.2 cd	10.3 ef	41.5 ab
		Novagib (GA)	2.5	4.5 ab	7.9 bcd	11.8 b-f	42.0 ab
			5	4.3 ab	7.2 cd	11.1 def	42.2 a
			10	4.2 ab	6.9 d	9.6 f	42.2 a

¹Applications were made 2 weeks after transplant (2WAT) or at visible bud (VB).²Mean separation with $P < 0.05$

Figure 40. Effect of various plant growth regulators on postharvest storage of Geranium ‘Pinto Red’, Runkle, 2008.



Catlin 2010

In 2010 Catlin (NY) conducted an initial screening of plant growth regulators applied as a foliar spray to assess phytotoxicity on geraniums. This initial screen prompted adjusting rates for some treatments for the postharvest experiments, as well as, including drench applications of ABA. Unseasonable heat made it difficult to determine if crop injury was due to treatments or heat in both the initial screen and the shelf life experiments.

On geraniums, the high rates of ABA drenches (250 and 500 ppm) resulted in some spotting on the lower leaves, and the high rate of ABA spray resulted in some foliar spotting. The high rates of TDZ (50 and 100 ppm) resulted in some foliar spotting and leaf distortion, giving a crinkled appearance, these symptoms were also observed at the lower rates of TDZ (5 and 10 ppm), but to less of a degree. The high rate of BA also resulted in some foliar spotting.

Table 41. Average crop injury ratings on Geranium from various plant growth regulator applications, Catlin, 2010.

Treatment, Rate	Geranium 'Maverick Pink'	Geranium 'Maestro Bright Red'
Maxcel (BA), 5 ppm	1.3 ab ²	1.7 a
Maxcel (BA), 10 ppm	2.3 abc	1.7 a
Maxcel (BA), 50 ppm	5.7 bc	2.3 a
Maxcel (BA), 100 ppm	6.0 c	1.7 a
Fascination (BA+GA), 5 ppm	3.7 abc	2.0 a
Fascination (BA+GA), 10 ppm	4.0 abc	3.7 a
Fascination (BA+GA), 50 ppm	3.3 abc	4.3 a
Fascination (BA+GA), 100 ppm	3.0 abc	1.7 a
Provide (GA), 5 ppm	1.0 ab	2.7 a
Provide (GA), 10 ppm	1.7 ab	2.0 a
Provide (GA), 50 ppm	1.3 ab	2.3 a
Provide (GA), 100 ppm	1.3 ab	3.3 a
Dropp (TDZ), 5 ppm	2.0 abc	3.0 a
Dropp (TDZ), 10 ppm	2.3 abc	4.7 a
Dropp (TDZ), 50 ppm	3.3 abc	5.0 a
Dropp (TDZ), 100 ppm	4.3 abc	6.3 a
VBC-30101 (ABA) 250 ppm	1.7 abc	3.3 a
VBC-30101 (ABA) 500 ppm	1.7 abc	2.3 a
VBC-30101 (ABA) 1000 ppm	2.7 abc	2.7 a
VBC-30101 (ABA) 125 ppm (drench)	1.0 a	2.7 a
VBC-30101 (ABA), 250 ppm (drench)	2.0 abc	3.0 a
VBC-30101 (ABA), 500 ppm (drench)	1.7 abc	1.3 a
Water control	1.3 ab	1.3 a

¹ 1=no phytotoxicity, 10=dead

² Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys's HSD (p=0.05).

The plants with the best appearance consistently across varieties were those treated with the 250 ppm and 500 ppm rates of ABA sprays and the 125 ppm and 250 ppm drenches of ABA – all of Results for: Geranium (*Pelargonium sp.*)

which increased the length of time until plant wilt in un-watered plants. The 5 ppm and 10 ppm rates of GA and the water controls also resulted in consistently good appearance across all varieties.

Table 42. Days to plant collapse for two varieties not watered once put into storage room, Catlin. 2010

Treatment	Geranium 'Maverick Pink'	Geranium 'Maestro Bright Red'
VBC-30101 (ABA), 250 ppm	26 a	22 a
VBC-30101 (ABA) 500 ppm	32 a	24 a
VBC-30101 (ABA) 125 ppm (drench)	36 a	20 a
VBC-30101 (ABA) 250 ppm (drench)	31 a	.
Water control	24 a	20 a

Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys's HSD (p=0.05).

Table 43. Average visual evaluation rating of BA, GA, BA+GA, TDZ, ABA treatments on two varieties of geranium, Catlin. 2010

Treatment	Geranium 'Maverick Pink'	Geranium 'Maestro Bright Red'
Maxcel (BA) 5 ppm	5.1 abc ^a	4.0 abcd
Maxcel (BA), 10 ppm	3.2 cde	3.1 cd
Maxcel (BA), 50 ppm	0.5 e	3.3 bcd
Maxcel (BA) 100 ppm	1.0 de	3.3 bcd
Fascination (BA+GA) 5 ppm	5.0 abc	5.6 ab
Fascination (BA+GA) 10 ppm	4.6 abc	5.2 abc
Fascination (BA+GA) 50 ppm	0.9 de	3.3 bcd
Fascination (BA+GA), 100 ppm	0.9 e	2.6 d
Provide (GA) 5 ppm	6.8 a	5.3 abc
Provide (GA) 10 ppm	6.5 ab	6.0 a
Provide (GA) 50 ppm	4.8 abc	3.9 abcd
Drop (TDZ) 5 ppm	3.6 bcd	3.6 bcd
Drop (TDZ) 10 ppm	3.0 cde	4.3 abcd
VBC-30101 (ABA) 250 ppm	5.7 abc	5.1 abc
VBC-30101 (ABA) 500 ppm	4.5 abc	4.6 abcd
VBC-30101 (ABA) 125 ppm (drench)	5.4 abc	4.3 abcd
VBC-30101 (ABA), 250 ppm (drench)	5.3 abc	3.9 abcd
Water control	5.7 abc	4.5 abcd

^a (0=unsalable, 10=highly attractive).

Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukey's HSD (p=0.05).

For the storage test, some differences between the treatments were seen in the visual evaluations, though few were statistically significant (Table 43). The 250 ppm and 500 ppm rates of ABA sprays, the 125 ppm and 250 ppm drenches of ABA, and the 5 ppm and 10 ppm rates of GA (with the exception of 'Divine White'), and the water controls were consistently of the better appearing plants in the trial. The 50 ppm and 100 ppm rates of BA+GA and the 50 ppm and 100 ppm rates of BA were consistently the least attractive plants in the trial. The results from the other treatments were somewhat mixed and mid-range compared to the best and worst listed above. The 5 ppm rate of BA resulted in higher visual ratings than the 10 ppm rate, and the 10 ppm rate of BA resulted in a lower rating than the control in all but 'Divine White', where it rated higher than the control. The 5 ppm and 10 ppm rates of BA+GA resulted in high ratings in both geranium varieties. The 5 ppm and the 10 ppm rate of TDZ resulted in very poor ratings for 'Divine White', and mid-range ratings for 'Maverick Pink' and 'Maestro Bright Red'. There were few treatments that were significantly different from the control plants in height, width, flower number, and bud number in any of the treatments (Table 44 and Table 45).

Due to the high heat and high light in the greenhouse, plants were particularly stressed before being placed in the storage boxes and the low light storage room. This resulted in *Botrytis* infection as well as root rot, and many plants were lost due to disease pressure, low light, and treatments. While numerous of the treatments showed an increase in visual attractiveness, under what conditions the plants become injured would need to be determined to guide growers to the best and safest application time and procedures.

Table 44. Geranium height, width, flower number, and bud number of plant growth regulator treatments for geranium ‘Maverick Pink’, Catlin, 2010.

Treatment	Geranium ‘Maverick Pink’									
	Height (in)			Width (in)		Flower No.			Bud No.	
	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27
Maxcel (BA) 5 ppm	7.1 a	7.0 a	7.7 a	12.5 a	11.1 a	1.2 a	0	0	1.0 ab	0
Maxcel (BA) 10 ppm	6.0 a	6.4 a	6.8 a	11.1 abc	9.5 a	2.0 a	0	0	0.8 ab	0
Maxcel (BA) 50 ppm	7.0 a	5.0 a	.	11.0 abc	.	1.2 a	0	.	0.8 ab	.
Maxcel (BA) 100 ppm	6.1 a	4.0 a	.	8.6 c	.	1.5 a	0	.	0.7 ab	.
Fascination (BA+GA) 5 ppm	7.5 a	6.3 a	6.5 a	11.5 ab	11.9 a	1.5 a	0	0	0.7 ab	0
Fascination (BA+GA) 10 ppm	8.3 a	8.2 a	8.4 a	12.2 ab	12.6 a	1.7 a	0	0	1.0 ab	
Fascination (BA+GA) 50 ppm	7.7 a	6.0 a	.	9.7 bc	.	1.7 a	0	.	0.8 ab	0
Fascination (BA+GA) 100 ppm	6.4 a	. ^A	.	8.9 c	.	1.0 a	.	.	0.8 ab	.
Provide (GA) 5 ppm	7.3 a	7.2 a	7.0 a	11.6 ab	11.6 a	1.5 a	0	0	0.8 ab	.
Provide (GA) 10 ppm	7.8 a	8.3 a	7.8 a	12.3 a	13.0 a	1.5 a	0	0	1.2 ab	0
Provide (GA) 50 ppm	7.8 a	6.6 a	7.5 a	12.0 ab	11.1 a	1.8 a	0	0	0.3 b	0
Drop (TDZ) 5 ppm	7.0 a	5.5 a	.	12.1 ab	.	1.3 a	0	.	1.7 a	.
Drop (TDZ), 10 ppm	7.3 a	6.3 a	.	10.8 abc	.	1.0 a	0	.	1.7 a	.
VBC -30101 (ABA) 250 ppm	8.9 a	4.5 a	7.7 a	12.7 a	12.3 a	2.0 a	0	0	2.4 a	1.4
VBC-30101 (ABA) 500 ppm	7.2 a	6.9 a	5.9 a	12.4 a	9.6 a	2.5 a	0	0	0.5 ab	0
VBC-30101 (ABA) 125 ppm (drench)	8.1 a	5.8 a	6.3 a	12.9 a	11.3 a	1.2 a	0	0	0.7 ab	0
VBC-30101 (ABA) 250 ppm (drench)	7.2 a	7.0 a	5.8 a	11.8 ab	10.8 a	1.2 a	0	0	0.8 ab	0
Water control	7.4 a	6.5 a	6.6 a	11.0 abc	10.5 a	1.2 a	0	0	0.5 ab	0

Table 45. Geranium height, width, flower number, and bud number of plant growth regulator treatments for geranium ‘Maestro Bright Red’, Catlin, 2010.

Treatment	Geranium ‘Maestro Bright Red’									
	Height (in)			Width (in)		Flower No.			Bud No.	
	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27
Maxcel (BA) 5 ppm	7.3 a	6.9 a	6.8 a	9.6 a	8.9 a	3.2 a	0 a	0	1.0 a	0
Maxcel (BA) 10 ppm	6.1 a	6.0 a	7.0 a	10.8 a	7.3 a	2.3 a	0 a	0	1.3 a	0
Maxcel (BA) 50 ppm	7.4 a	7.0 a	5.8 a	12.7 a	9.0 a	2.0 a	0 a	0	0.8 a	0
Maxcel (BA) 100 ppm	6.3 a	5.6 a	8.0 a	10.6 a	11.5 a	1.5 a	0 a	0	1.2 a	0
Fascination (BA+GA) 5 ppm	7.7 a	7.3 a	7.2 a	10.7 a	10.0 a	2.2 a	0 a	0	1.3 a	0
Fascination (BA+GA) 10 ppm	6.6 a	6.8 a	6.9 a	11.1 a	10.6 a	1.3 a	0.3 a	0	1.2 a	0
Fascination (BA+GA) 50 ppm	6.8 a	6.7 a	5.5 a	10.4 a	9.2 a	1.2 a	0 a	0	2.0 a	0
Fascination (BA+GA) 100 ppm	6.1 a	3.5 a	.	10.6 a	.	1.7 a	0 a	.	1.2 a	.
Provide (GA), 5 ppm	6.5 a	6.9 a	6.0 a	11.4 a	11.4 a	2.2 a	0 a	0	1.0 a	0
Provide (GA) 10 ppm	7.8 a	7.9 a	6.8 a	11.5 a	10.5 a	1.8 a	0 a	0	1.5 a	0
Provide (GA) 50 ppm	6.1 a	6.5 a	6.3 a	10.6 a	11.2 a	2.0 a	0 a	0	1.5 a	0
Drop (TDZ) 5 ppm	7.0 a	6.4 a	.	10.8 a	.	1.3 a	0 a	.	1.3 a	.
Drop (TDZ), 10 ppm	6.7 a	6.5 a	10.0 a	11.3 a	10.0 a	0.8 a	0 a	0	1.5 a	0
VBC-30101 (ABA), 250 ppm	6.3 a	6.2 a	5.6 a	11.6 a	8.1 a	1.8 a	0 a	0	1.0 a	1.8
VBC-30101 (ABA), 500 ppm	6.1 a	6.3 a	5.2 a	9.8 a	7.8 a	1.7 a	0 a	0	1.3 a	0
VBC-30101 (ABA), 125 ppm (drench)	6.5 a	5.9 a	5.0 a	10.6 a	10.3 a	1.3 a	0 a	0	0.8 a	0
VBC-30101 (ABA) 250 ppm (drench)	6.0 a	5.9 a	5.7 a	10.7 a	9.3 a	2.0 a	0 a	0	1.2 a	0
Water control	6.4 a	6.2 a	5.3 a	10.5 a	8.6 a	1.0 a	0 a	0	0.8 a	0

Comparative Efficacy on *Impatiens* (*Impatiens walleriana*)



In 2006, Pemberton examined four products: Fascination, Maxcel and Provide all at 100 ppm and a standard EthylBloc at 1 ppm. Of these, the products with GA₄₊₇ (Fascination and Provide) increased flower number in one of three cultivars and height in 3 of 3 cultivars. EthylBloc and Maxcel generally had no effect.

Pemberton 2006

In 2006, Pemberton conducted an experiment to determine the effect of four products on shelf life of *impatiens* cultivars ‘Super Elfin Burgundy’, ‘Super Elfin Cajun Bayou Mix’, ‘Super Elfin Orange’ and ‘Super Elfin Red’. Fascination, Maxcel and Provide were applied at 100 ppm and the standard EthylBloc at 1 ppm. Two days after treatment, plants were subjected to simulated shipping (21C in the dark for 48 hours) and moved to an interior postharvest evaluation room.

Initial performance ratings where 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering were slightly different at the beginning of the experiment for some of the cultivars, but were either just slightly or not significantly different by the end of the simulated shipping period (Table 46 - Table 50). The treatment differences in performance ratings of the plants at each evaluation date were either small or not significant during the postharvest period. However, Fascination and Provide increased flower number during the postharvest period for ‘Super Elfin Burgundy’ (Table 46). Late in the evaluation period, stretching was noted. Fascination and Provide increased height by about 50% for ‘Super Elfin Burgundy’, ‘Orange’, and ‘Red’ (Table 46, Table 49, Table 50). ‘Cajun Bayou Mix’ heights were not measured as the plants were not very uniform due to the fact that it was a mix. This effect needs to be more closely monitored in future studies as it was not noticeable until late in the evaluation period.

Products containing GA₄₊₇ may be useful for increasing flowering during the postharvest period as long as plants don’t remain on the shelf for an extended period. This effect could also depend on the marketing environment light levels and the use of growth retardants prior to harvest.

Table 46. Effect of several PGR's on the Postharvest Performance of Impatiens (*Impatiens sp.*) 'Super Elfin Burgundy', Pemberton, 2006.

Treatment	Evaluations				
	6/27/06 ^a	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄₊₇) 100 ppm	7.5 c	7.6	7.3 a	6.6 b	7.0 a
MaxCel (6-BA) 100 ppm	8.0 b	7.3	6.2 b	6.5 b	6.7 ab
ProVide (GA ₄₊₇) 100 ppm	7.7 bc	7.6	7.2 a	7.3 a	7.0 a
EthylBloc (1-MCP) 1 ppm	8.6 a	7.6	6.2 b	6.5 b	6.3 b
Untreated	8.6 a	7.6	6.3 b	6.3 b	6.3 b
ANOVA	**	NS	**	*	*
Number of Flowers					
Fascination (6-BA + GA ₄₊₇) 100 ppm	21.4	23.4	13.9 a	5.9 b	9.1 ab
MaxCel (6-BA) 100 ppm	21.6	21.8	5.5 c	4.9 b	5.3 bc
ProVide (GA ₄₊₇) 100 ppm	22.4	23.6	10.9 ab	10.8 a	10.5 a
EthylBloc (1-MCP) 1 ppm	26.1	23.9	5.0 c	4.6 b	3.1 c
Untreated	27.9	25.5	7.4 bc	4.5 b	3.4 c
ANOVA	NS	NS	**	*	**
Height					
Fascination (6-BA + GA ₄₊₇) 100 ppm				24.1 a	
MaxCel (6-BA) 100 ppm				13.5 b	
ProVide (GA ₄₊₇) 100 ppm				20.9 a	
EthylBloc (1-MCP) 1 ppm				13.0 b	
Untreated				13.9 b	
ANOVA				**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^b The performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Figure 47. The effect of growth regulators at the end of the experiment for impatiens ‘Super Elfin Burgundy’.



Treatments are from the left: Provide, MaxCel, Fascination, EthylBloc, and untreated. Note the height and flowering differences for Super Elfin Burgundy. Pemberton

Table 48. Effect of several PGR's on the Postharvest Performance of Impatiens (*Impatiens* sp.) ‘Super Elfin Cajun Bayou Mix’, Pemberton 2006.

Treatment	Evaluations				
	6/27/06 ^a	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄₊₇) 100 ppm	7.1	6.9	6.9	7.0	7.1
MaxCel (6-BA) 100 ppm	7.5	7.4	7.3	7.3	7.0
ProVide (GA ₄₊₇) 100 ppm	7.1	7.1	6.8	6.9	7.3
EthylBloc (1-MCP) 1 ppm	7.3	7.3	6.9	7.0	7.1
Untreated	7.3	6.9	7.3	6.9	7.3
ANOVA	NS	NS	NS	NS	NS
Number of Flowers					
Fascination (6-BA + GA ₄₊₇) 100 ppm	11.6	12.5	8.8	10.9	20.5
MaxCel (6-BA) 100 ppm	16.1	15.0	11.1	11.5	15.6
ProVide (GA ₄₊₇) 100 ppm	12.9	12.0	7.6	8.8	18.3
EthylBloc (1-MCP) 1 ppm	15.8	15.3	8.3	10.4	15.4
Untreated	13.8	12.6	10.9	8.8	17.4
ANOVA	NS	NS	NS	NS	NS

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 49. Effect of several PGR's on the Postharvest Performance of Impatiens (*Impatiens* sp.) ‘Super Elfin Orange’, Pemberton 2006.

Results for: *Impatiens* (*Impatiens walleriana*)

Treatment	Evaluations				
	6/27/06 ^a	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄₊₇) 100 ppm	7.3 b	7.0	6.5 b	6.6	6.6 bc
MaxCel (6-BA) 100 ppm	7.4 ab	7.0	6.6 b	7.0	6.9 ab
ProVide (GA ₄₊₇) 100 ppm	7.0 b	6.8	6.3 b	6.5	6.4 c
EthylBloc (1-MCP) 1 ppm	7.8a	7.1	7.5 a	7.3	7.1 a
Untreated	7.0b	6.6	6.8 b	6.9	6.8 abc
ANOVA	*	NS	**	NS	*
Number of Flowers					
Fascination (6-BA + GA ₄₊₇) 100 ppm	10.9	7.3	6.3	5.4 b	5.9
MaxCel (6-BA) 100 ppm	12.3	11.1	8.1	8.1 ab	8.5
ProVide (GA ₄₊₇) 100 ppm	8.5	7.3	5.1	5.4 b	4.9
EthylBloc (1-MCP) 1 ppm	13.5	10.8	10.1	11.4 a	9.6
Untreated	9.5	6.3	7.1	8.1 ab	6.1
ANOVA	NS	NS	NS	*	NS
Height					
Fascination (6-BA + GA ₄₊₇) 100 ppm				27.4 a	
MaxCel (6-BA) 100 ppm				19.7 b	
ProVide (GA ₄₊₇) 100 ppm				25.1 a	
EthylBloc (1-MCP) 1 ppm				19.1 b	
Untreated				18.9 b	
ANOVA				**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06.

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 50. Effect of several PGR's on the Postharvest Performance of Impatiens (*Impatiens* sp.) 'Super Elfin Red', Pemberton, 2006.

Treatment	Evaluations				
	6/27/06 ^a	6/29/06	7/6/06	7/13/06	7/20/06
Performance Rating ^b					
Fascination (6-BA + GA ₄ + 7)	7.1 c	7.1 c	7.4	7.3	7.3
MaxCel (6-BA)	7.3 c	7.3 bc	7.0	7.1	7.0
ProVide (GA ₄ + 7)	7.3 c	7.5 abc	7.6	7.4	7.1
EthylBloc (1-MCP)	8.4 a	7.8 ab	7.1	7.3	7.0
Untreated	7.8 b	7.9 a	7.4	7.3	7.4
ANOVA	*	*	NS	NS	NS
Number of Flowers					
Fascination (6-BA + GA ₄ + 7)	11.5 c	10.4 b	12.5	15.1	20.9
MaxCel (6-BA)	13.4 bc	12.1 b	10.9	10.3	12.9
ProVide (GA ₄ + 7)	15.6 bc	13.5 b	14.3	13.3	20.0
EthylBloc (1-MCP)	24.1 a	20.0 a	10.0	11.6	13.0
Untreated	18.3 ab	15.0 ab	12.6	12.6	16.8
ANOVA	*	*	NS	NS	NS
Height					
Fascination (6-BA + GA ₄ + 7)				31.4 a	
MaxCel (6-BA)				18.9 b	
ProVide (GA ₄ + 7)				27.4 a	
EthylBloc (1-MCP)				19.6 b	
Untreated				20.5 b	
ANOVA				**	

^a Fascination, Maxcel and Provide applied 6/24/06, EthylBloc applied 6/26/06

^bThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Comparative Efficacy on *Impatiens hybrida*, New Guinea *Impatiens*



Four researchers examined the effects of plant growth regulators on New Guinea Impatiens. In a single experiment, applications of 10 ppm ABA demonstrated a delay in days to wilting for ‘Super Sonic Flame’ (Table 65). The other treatments showed little to no beneficial response on shelf life or plant quality. Products with GA₄₊₇ (Fascination and Provide) had negative effects on the impatiens plants. Plants were too tall, and abscised too many leaves. Provide also reduced flower-bud development. Although Argylene reduced flower bud abscission, it also resulted in damaged flowers. TDZ increased flower bud abscission. Maxcel increased flower bud numbers but also increased abscission.

Reid 2007

In 2007, Reid conducted an experiment to determine the effect of five products on shelf life of four impatiens cultivars ‘Jewels Red’, ‘Pink’, ‘Violet’ and ‘White’. Fascination, Maxcel and Provide were applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. The number of dropped leaves, damaged flowers, developed and dropped flower buds, as well as plant height, were recorded. Treatment effects were variable depending on the cultivar. In general, plants treated with PGR’s containing cytokinins or with cytokinin activity (Maxcel, Fascination, TDZ) showed a tendency to higher numbers of developed buds (Table 51). Argylene was the only treatment that consistently caused more flower damage. Fascination caused more flower damage only in the “White” cultivar and the other treatments had no effect. In general, the untreated control and Argylene showed significantly less flower bud abscission than other PGRs (Table 52). PGR’s containing GA₄₊₇ (Fascination and Provide) caused a higher percentage of flower bud abscission and a three-fold increase in leaf abscission in all impatiens cultivars during three weeks of display life after simulated shipping. Other treatments did not affect leaf abscission. After 9 and 23 DAT, plants treated with Fascination and Provide had grown much taller than the untreated control for all cultivars (Table 53). Other treatments did not affect plant height (data not shown).

The results of this trial show that the products with GA₄₊₇ Fascination and Provide had negative effects on the impatiens plants. Plants were too tall, and abscised too many leaves and flower buds. Provide also reduced flower-bud development. Although Argylene reduced flower bud abscission, it also resulted in damaged flowers. TDZ increased flower bud abscission. Maxcel increased flower bud numbers but also increased abscission.

Table 51. Effect of several PGR's on Development and Number of Damaged Flowers of Impatiens cultivars 'Jewels Red', 'Pink', 'Violet' and 'White' (*Impatiens* sp.), Reid, 2007.

Treatment	Number of Flower Buds ^z at 19 DAT				Number of Damaged Flowers			
	'Jewels Red'	'Pink'	'Violet'	'White'	'Jewels Red'	'Pink'	'Violet'	'White'
Argylene XM (STS) 0.5 mM	35.3 ab	33.0 ab	33.6 a	33.1 abc	2.1 b	0.7 b	3.8 b	1.7 c
Fascination (6-BA + GA ₄₊₇) 100 ppm	30.0 ab	25.7 a	35.2 a	37.1 c	0.1 a	0 a	0.1 a	1.3 bc
MaxCel (6-BA) 100 ppm	39.3 b	38.4 b	48.9 b	34.6 abc	0.5 a	0.1 a	0.2 a	0.4 a
Provide (GA ₄₊₇) 100 ppm	24.8 a	25.6 a	34.5 a	27.7 ab	0.3 a	0.3 ab	0.3 a	0.5 ab
TDZ (Thidiazuron) 5 uM	37.5 b	35.8 b	30.0 a	36.0 bc	0 a	0 a	0 a	0 a
TDZ (Thidiazuron) 10 uM	40.0 b	34.8 b	31.6 a	36.2 bc	0.1 a	0 a	0 a	0.2 a
Untreated	33.3 ab	35.6 b	32.0 a	26.6 a	0 a	0 a	0 a	0 a

^z Means in the same column followed by the same letter are not significantly different.

Table 52. Effect of several PGR's on Flower Bud and Leaf Abscission of Impatiens cultivars 'Jewels Red', 'Pink', 'Violet' and 'White' (*Impatiens* sp.), Reid, 2007.

Treatment	Dropped Flower Buds (%) ^z				Number of Dropped Leaves 25 DAT			
	'Jewels Red'	'Pink'	'Violet'	'White'	'Jewels Red'	'Pink'	'Violet'	'White'
Argylene XM (STS) 0.5 mM	15.4 a	10.9 a	11.7 a	21.3 ab	5.1 ab	4.3 a	7.0 a	3.5 a
Fascination (6-BA + GA ₄₊₇) 100 ppm	69.7 c	42.2 d	60.8 c	60.4 d	8.1 bc	14.2 b	31.3 b	17.7 b
MaxCel (6-BA) 100 ppm	39.4 b	36.6 cd	35.7 b	31.6 bc	5.2 ab	4.0 a	10.4 a	7.4 a
Provide (GA ₄₊₇) 100 ppm	47.4 b	43.1 d	38.8 b	57.2 d	10.2 c	16.8 b	24.8 b	16.5 b
TDZ (Thidiazuron) 5 uM	45.2 b	30.4 cd	37.9 b	35.1 c	3.2 a	3.0 a	7.0 a	3.9 a
TDZ (Thidiazuron) 10 uM	42.6 b	27.8 bc	36.0 b	36.6 c	5.2 ab	2.4 a	11.1 a	6.6 a
Untreated	35.9 b	16.9 ab	15.8 a	10.6 a	5.4 ab	3.4 a	8.8 a	4.1 a

^z Means in the same column followed by the same letter are not significantly different.

Table 53. Effect of several PGR's on Plant Height of Impatiens cultivars 'Jewels Red', 'Pink', 'Violet' and 'White' (*Impatiens* sp.), Reid 2007.

Treatment	Plant Height (cm) ^z at 9 DAT			
	'Jewels Red'	'Pink'	'Violet'	'White'
Fascination (6-BA + GA ₄₊₇) 100 ppm	13.8 b	13.4 b	14.2 b	12.0 b
Provide (GA ₄₊₇) 100 ppm	15.4 c	16.1 c	18.6 c	14.2 c
Untreated	9.8 a	10.0 a	10.1 a	7.5 a
	Plant Height (cm) at 23 DAT			
	'Jewels Red'	'Pink'	'Violet'	'White'
Fascination (6-BA + GA ₄₊₇) 100 ppm	18.8 b	17.0 b	20.4 b	17.7 b
Provide (GA ₄₊₇) 100 ppm	19.3 b	21.1 c	23.9 c	18.9 b
Untreated	10.2 a	8.5 a	10.4 a	8.6 a

Chen 2008

In 2008, Chen studied the impact of five (5) products on the number of open flowers through 28 days after application. The two New Guinea impatiens cultivars were 'Electric Orange' and 'Harmony Red'. Phytotoxicity was also assessed on a scale of 0 to 10.

Overall, 'Harmony Red' had fewer open flowers than 'Electric Orange' (Table 43 and Table 44). Plants in two BA treatments had similar or fewer number of flowers than those of control plants. By 21 days after application, GA₄ at 100 ppm increased number of open flowers on 'Electric Orange' and 1-MCP increased number of open flowers on 'Harmony Red'. Foliar distortion was found in 'Harmony Red' as leaf puckering in GA₄, BA, and 1-MCP treated plants (Table 57). One negative effect was observed as stem stretching (longer internode) in 'Electric Orange' with the GA₄₊₇ plus BA treatment causing the most severe stretching (as shown in plant height, data not shown). 'Harmony Red' treated with GA₄₊₇ plus BA exhibited some stretching but not as severe as 'Electric Orange'. By 28 days after treatment, 'Electric Orange' maintained marketable visual quality regardless of the stretching effect from PGR treatments, and 'Harmony Red' treated with deionized water or GA₄₊₇ plus BA had more desirable visual quality (Table 58 and price

Table 59). Based on these results, application of GA₄ or 1-MCP increased the number of open flowers temporarily but none of the PGR treatments enhanced post-production quality as reflected by the visual plant quality ratings.

Table 54. Numbers of open flowers in 'Electric Orange' New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Number of open flowers				
		Day 1	Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	2	2.9	4.9	7.1 ab	3.4
ExilisPlus	100 ppm	1.9	3.3	6.3	6.4 b	6
MaxCel	100 ppm	1.6	2.9	5.3	6.4 b	6.8
NovaGib	100 ppm	1.8	2.6	5.8	8.3 a	5.4
MCP	1 ppm	1.6	2.6	6	4.6 b	5.4
Untreated		1.4	3	6	5.4 b	4.3

LSD _{0.05}	NS*	NS	NS	1.8	NS
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* No significant difference was found among treatments.

Table 55. Numbers of open flowers in ‘Harmony Red’ New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Number of open flowers				
		Day 1	Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	1.6	2	1.6 b	1	1.8
ExilisPlus	100 ppm	0.8	2	2.6 b	1.5	2.1
MaxCel	100 ppm	1.3	2	1.6 b	1.6	3.6
NovaGib	100 ppm	2.4	2	2.1 b	0.4	1.3
MCP	1 ppm	1	2.6	4.5 a	1.8	2
Untreated		1.9	3.1	1	1.9	3
LSD _{0.05}		NS*	NS	2.1	NS	NS

* No significant difference was found among treatments.

Table 56. Phytotoxicity ratings of ‘Electric Orange’ New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Phytotoxicity (0 to 10) *			
		Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	6	2.3	3	1.3
ExilisPlus	100 ppm	2.1	0.3	0.5	0.3
MaxCel	100 ppm	3	0	1.1	0.1
NovaGib	100 ppm	1.1	2	2.8	1.8
MCP	1 ppm	0	0.1	0.8	0.1
Untreated		0	0	0	0
LSD _{0.05}		0.3	0.3	0.4	0.3

*Ratings in a scale of 0 to 10 were assigned to plants based on observations on leaf pickling and edge burning, where 0 represents no pickling and burning, and 10 represents severe pickling or burning. Stretching of stems were observed but not taken into consideration of phytotoxicity ratings because it was not a true type of injury.

Table 57. Phytotoxicity ratings of ‘Harmony Red’ New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Phytotoxicity (0 to 10) *			
		Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	0.6	0	3.6	2.9
ExilisPlus	100 ppm	0	0	4.9	5.3
MaxCel	100 ppm	0	0	5.8	4.1
NovaGib	100 ppm	0.8	0	5.5	5
MCP	1 ppm	0	0	5.9	3.9
Untreated		0	0	2.1	1.9
LSD _{0.05}		0.25	0	0.66	1.9

*Ratings in a scale of 0 to 10 were assigned to plants based on observations on leaf pickling and edge burning, where 0 represents no pickling and burning, and 10 represents severe pickling or burning. Stretching of stems were observed but not taken into consideration of phytotoxicity ratings because it was not a true type of injury.

Table 58. Visual quality ratings of ‘Electric Orange’ New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Visual Quality Rating ^a				
		Day 1	Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	9.9	5	8.9	10	8.4
ExilisPlus	100 ppm	10	8	10	9.6	8.8
MaxCel	100 ppm	9.8	8.5	9.3	10	8.6
NovaGib	100 ppm	9.6	7.8	9.4	9.9	8.6
MCP	1 ppm	10	8.9	10	10	9.1
Untreated		10	9.1	9.4	10	8.9
LSD _{0.05}		0.2	0.3	0.3	0.2	0.4

^a Visual quality (on a scale of 1 to 10 where 1 to 4 being unsalable, 5 to 8 being marketable at a discounted price, and 9 to 10 being highly attractive and marketable at a premium price)

Table 59. Visual quality ratings of ‘Harmony Red’ New Guinea impatiens after an application of GA₄₊₇ plus BA (Fascination), BA (ExilisPlus or MaxCel), and GA₄ (NovaGib), Chen, 2008.

Treatment	Rate	Visual Quality Rating ^a				
		Day 1	Day 7	Day 14	Day 21	Day 28
Fascination	100 ppm	8.5	7.5	6.9	7.1	7.4
ExilisPlus	100 ppm	8.4	8.8	6.6	6.5	4.9
MaxCel	100 ppm	8.5	9	7.8	7.5	6.6
NovaGib	100 ppm	8.8	7.8	6.3	5.9	5.8
MCP	1 ppm	8.6	9	7.1	7.4	6.6
Untreated	water	8.6	9.8	7.8	8	8.4
LSD _{0.05}		NS	0.8	0.8	1.0	1.0

^a Visual quality (on a scale of 1 to 10 where 1 to 4 being unsalable, 5 to 8 being marketable at a discounted price, and 9 to 10 being highly attractive and marketable at a premium price)

Pemberton 2009

In 2009, Pemberton compared impatiens grown and treated in Texas and subjected to simulated shipping to those grown and treated in California and actually shipped to Texas for assessment. Plants grown in Texas were subjected to simulated shipping 1DAT (68F [20C] in the dark for 48 hours) and then moved to an interior postharvest evaluation room. The evaluation room was kept at 70F (21C) with 13 $\mu\text{mol m}^{-2} \text{sec}^{-1}$ PAR from fluorescent lighting for 12 hours each day. Plants were watered as needed with de-ionized water except for plants evaluated for time to wilt. These plants were watered at the end of the shipping period and then allowed to reach the wilting stage without any additional watering. Plants grown in California were treated 24 hrs prior to shipping to Texas (actual shipping) where they were then evaluated. The evaluation conditions were the same as for Texas grown plants.

The New Guinea cultivars used in these studies showed very little in the way of beneficial responses to the growth regulators used when plants were evaluated over a three week period for postharvest performance and flower number. For experiments originating in Texas, the ABA and Provide treated plants performed as well as the controls over the course of the evaluation.

The only exception was a reduction of flowers on Sonic Sweet Cherry when comparing Provide treated plants to the control for the last two evaluation dates (Table 62). Also, the ABA treated plants had more flowers than the control on the last evaluation date. Plants treated with Fascination, MaxCel, and Dropp also were similar to the untreated control, except for Sonic Sweet Cherry (Error! Reference source not found., Table 60. The effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Sonic Light Lavender’ grown and evaluated in Texas, Pemberton, 2009.

Treatment	Evaluation				
	January 28	January 30	February 6	February 11	February 19
Performance Rating ^a					
ABA 100 ppm	9.5	9.2 a	8.2	8.0 a	8.2 a
Fascination 100 ppm	9.8	9.3 a	8.3	8.5 a	7.7 abc
MaxCel 100 ppm	9.5	8.0 b	8.0	7.0 b	6.8 c
ProVide 100 ppm	9.7	9.5 a	8.5	8.7 a	8.0 ab
Dropp 1 ppm	9.8	9.8 a	8.3	8.2 a	7.2 bc
Untreated	9.7	9.5 a	9.2	8.5 a	7.5 abc
ANOVA	NS	**	NS	**	*
Number of Flowers					
ABA 100 ppm	3.0	4.0	2.2	3.5 a	8.2 a
Fascination 100 ppm	3.7	4.7	4.5	3.5 a	7.7 abc
MaxCel 100 ppm	3.8	4.8	2.5	1.0 b	6.8 c
ProVide 100 ppm	3.0	3.3	3.3	3.3 a	8.0 ab
Dropp 1 ppm	3.8	4.2	2.7	1.5 b	7.2 bc
Untreated	4.2	5.7	6.2	3.5 a	7.5 abc
ANOVA	NS	NS	NS	**	*

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 61). For this cultivar, performance was reduced by these three compounds in comparison to the control for the last two evaluation dates (Table 62). Also, flower number was reduced by all three compounds on the fourth evaluation date, but by only MaxCel on the last evaluation date.

In experiments where plants were actually shipped from California to Texas, there was no effect of chemical treatment except that Dropp treated plants had lower performance ratings and flower number than the controls for both of the last two evaluation dates (Table 63 and Table 64). This was true for both Sonic Light Lavender and Sonic Sweet Cherry plants.

The most significant finding of this series of experiments is the delay in wilting seen in response to ABA treatment. ABA treatment resulted in an increase in days to wilting for Super Sonic Flame plants grown in Texas and Sonic Sweet Cherry plants grown in California (Table 65). Thus, the response to ABA was seen even after commercial shipping. The difference between treatments was not significant for the other cultivars studied. The shorter number of days to wilting for Sonic Light Lavender and Sonic Sweet Cherry plants grown and evaluated in Texas was likely due to being grown in 10 cm pots resulting in a root bound condition at the time of simulated shipping, whereas the rest of the plants were grown in 15 cm pots resulting in a lack of root restriction. Further studies are needed to determine the effect of ABA on other cultivars of

this species, to learn more about the interaction between rate and cultivar, and to determine the extent of the effect of a root bound condition on the delayed wilting response to ABA treatment.

Table 60. The effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Sonic Light Lavender’ grown and evaluated in Texas, Pemberton, 2009.

Treatment	Evaluation				
	January 28	January 30	February 6	February 11	February 19
Performance Rating ^a					
ABA 100 ppm	9.5	9.2 a	8.2	8.0 a	8.2 a
Fascination 100 ppm	9.8	9.3 a	8.3	8.5 a	7.7 abc
MaxCel 100 ppm	9.5	8.0 b	8.0	7.0 b	6.8 c
ProVide 100 ppm	9.7	9.5 a	8.5	8.7 a	8.0 ab
Dropp 1 ppm	9.8	9.8 a	8.3	8.2 a	7.2 bc
Untreated	9.7	9.5 a	9.2	8.5 a	7.5 abc
ANOVA	NS	**	NS	**	*
Number of Flowers					
ABA 100 ppm	3.0	4.0	2.2	3.5 a	8.2 a
Fascination 100 ppm	3.7	4.7	4.5	3.5 a	7.7 abc
MaxCel 100 ppm	3.8	4.8	2.5	1.0 b	6.8 c
ProVide 100 ppm	3.0	3.3	3.3	3.3 a	8.0 ab
Dropp 1 ppm	3.8	4.2	2.7	1.5 b	7.2 bc
Untreated	4.2	5.7	6.2	3.5 a	7.5 abc
ANOVA	NS	NS	NS	**	*

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 61. The effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Super Sonic Flame’ grown and evaluated in Texas. Pemberton 2009

Treatment	Evaluation				
	January 28	January 30	February 6	February 11	February 19
Performance Rating ^a					
ABA 100 ppm	9.4	9.2	8.6	8.6	8.6
Fascination 100 ppm	9.8	9.2	8.6	8.8	7.2
MaxCel 100 ppm	9.6	8.4	8.8	9.0	8.2
ProVide 100 ppm	9.2	8.6	8.4	8.0	8.0
Dropp 1 ppm	9.6	8.4	8.4	8.2	7.0
Untreated	9.4	9.2	8.6	8.4	8.2
ANOVA	NS	NS	NS	NS	NS
Number of Flowers					
ABA 100 ppm	3.4	3.8	5.8	6.2	5.6
Fascination 100 ppm	3.8	4.2	4.2	2.0	2.2
MaxCel 100 ppm	4.2	5.0	5.6	6.6	5.0
ProVide 100 ppm	2.8	3.0	4.2	3.6	3.8
Dropp 1 ppm	2.8	3.6	3.0	4.0	2.4
Untreated	3.8	4.4	5.6	5.4	6.2
ANOVA	NS	NS	NS	NS	NS

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 62. The effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Sonic Sweet Cherry’ grown and evaluated in Texas. Pemberton, 2009.

Treatment	Evaluations				
	January 28	January 30	February 6	February 11	February 19
Performance Rating ^a					
ABA 100 ppm	9.8	10.0 a	9.5 a	9.7 a	9.2 a
Fascination 100 ppm	9.8	9.0 dc	8.0 b	7.6 c	7.0 c
MaxCel 100 ppm	9.5	8.5 d	7.8 b	7.7 c	7.0 c
ProVide 100 ppm	9.8	9.7 ab	9.0 a	8.7 b	8.0 bc
Dropp 1 ppm	9.7	9.2 bc	8.8 a	7.8 c	7.0 c
Untreated	9.8	10.0 a	9.5 a	9.5 a	8.2 b
ANOVA	NS	**	**	**	**
Number of Flowers					
ABA 100 ppm	5.3	6.8	10.3 a	8.0 a	6.4 a
Fascination 100 ppm	4.2	5.2	4.3 c	0.4 d	1.3 bc
MaxCel 100 ppm	4.3	4.8	4.7 c	1.0 cd	0.7 c
ProVide 100 ppm	4.2	5.8	6.2 bc	1.8 bc	1.2 c
Dropp 1 ppm	3.7	4.7	8.2 ab	3.0 b	1.5 bc
Untreated	4.2	6.0	8.7 ab	6.8 a	2.8 b
ANOVA	NS	NS	**	**	**

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 63. Effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Sonic Light Lavender’ grown in California and evaluated in Texas. Pemberton 2009

Treatment	Evaluation			
	29 January	5 February	11 February	19 February
Performance Rating ^a				
ABA 100 ppm	8.6	7.0	7.4 a	7.2 a
Fascination 100 ppm	7.8	6.8	6.2 a	6.2 a
MaxCel 100 ppm	8.2	6.4	6.6 a	4.8 ab
ProVide 100 ppm	7.8	6.8	7.2 a	7.4 a
Dropp 1 ppm	7.4	6.6	3.0 b	2.8 b
Untreated	8.2	5.6	5.4 a	6.2 a
ANOVA	NS	NS	**	*
Number of Flowers				
ABA 100 ppm	2.6	2.4 a	2.6 a	2.0
Fascination 100 ppm	2.2	1.0 b	0.0 b	1.0
MaxCel 100 ppm	1.4	0.4 b	1.2 ab	1.0
ProVide 100 ppm	0.8	0.6 b	2.0 a	2.8
Dropp 1 ppm	1.0	0.0 b	0.0 b	0.0
Untreated	2.4	0.6 b	1.4 a	2.2
ANOVA	NS	*	**	NS

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 64. Effect of growth regulators on the postharvest performance of New Guinea impatiens ‘Sonic Sweet Cherry’ grown in California and evaluated in Texas. Pemberton, 2009.

Treatment	Evaluations			
	29 January	5 February	11 February	19 February
Performance Rating ^a				
ABA 100 ppm	9.0 a	9.0	8.5 a	8.8 a
Fascination 100 ppm	8.8 a	8.3	8.3 a	8.3 a
MaxCel 100 ppm	8.5 a	7.8	7.3 a	7.5 a
ProVide 100 ppm	7.3 b	7.8	7.3 a	7.3 a
Dropp 1 ppm	7.5 b	7.5	2.5 b	2.5 b
Untreated	9.3 a	8.3	8.8 a	8.0 a
ANOVA	**	NS	**	**
Number of Flowers				
ABA 100 ppm	3.0	5.5 a	5.0 a	9.8 a
Fascination 100 ppm	3.0	4.0 ab	5.0 a	8.3 a
MaxCel 100 ppm	3.5	2.5 bc	3.5 ab	5.0 b
ProVide 100 ppm	2.75	2.8 bc	2.8 b	5.0 b
Dropp 1 ppm	2.25	0.5 c	0.3 c	0.3 c
Untreated	3.0	3.5 ab	4.8 ab	7.0 ab
ANOVA	NS	*	**	**

^aThe performance rating was assigned based on a scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering.

Table 65. The effect of ABA on the postharvest wilting of New Guinea impatiens grown in Texas and California, but all evaluated in Texas, Pemberton, 2009.

Cultivar	Treatment	Time to wilt after shipping (days) *
<i>Plants grown in Texas</i>		
Sonic Light Lavender	ABA	6.2 ns
	Untreated	5.8 ns
Sonic Sweet Cherry	ABA	5.5 ns
	Untreated	5.0 ns
Super Sonic Flame	ABA	12.6 a
	Untreated	9.0 b
<i>Plants grown in California</i>		
Sonic Light Lavender	ABA	10.8 ns
	Untreated	11.0 ns
Sonic Sweet Cherry	ABA	12.3 a
	Untreated	10.0 b

* Plants were rewatered after shipping, but were not watered again during the evaluation.

Catlin 2010

In 2010, Catlin (NY) conducted an initial screening of plant growth regulators applied as a foliar spray to assess phytotoxicity on New Guinea impatiens. This initial screen prompted adjusting

rates for some treatments for the postharvest experiments, as well as, including drench applications of ABA. Unseasonable heat made it difficult to determine if crop injury was due to treatments or heat in both the initial screen and the shelf life experiments.

On impatiens, the higher rates (250 and 500ppm) of ABA drenches resulted in some foliar spotting or scorch symptoms as well as some flower spotting, and the higher rates of ABA sprays (500ppm and 1000ppm) also resulted in some foliar spotting. A few foliar spots were also observed for the low rate of ABA spray (250 ppm). The high rates of TDZ sprays (50 and 100 ppm) resulted in flower spotting, upper leaf curl, some leaf yellowing, and green color on flowers, and the 10 ppm rate resulted in slight yellowing of foliage and slight curling of upper leaf margins. Higher rates of GA sprays (50 and 100 ppm), resulted in taller plants with a stretched appearance, and the low rate of GA (5 ppm) some leaf spotting was observed. BA (100ppm) resulted in numerous leaf spots and scorch and some distortion of the upper leaves.

Table 66. Average crop injury ratings on New Guinea Impatiens from various plant growth regulator applications, Catlin, 2010.

Treatment, Rate	Phytotoxicity	
	New Guinea Impatiens 'Divine White'	New Guinea Impatiens 'Infinity White'
Maxcel (BA), 5 ppm	1.3 a	1.3 ab
Maxcel (BA), 10 ppm	2.7 abcd	1.7 ab
Maxcel (BA), 50 ppm	1.7 a	1.0 a
Maxcel (BA), 100 ppm	3.7 abcd	2.0 ab
Fascination (BA+GA), 5 ppm	2.0 ab	2.0 ab
Fascination (BA+GA), 10 ppm	1.3 a	1.3 ab
Fascination (BA+GA), 50 ppm	2.7 abcd	1.3 ab
Fascination (BA+GA), 100 ppm	4.0 abcd	1.7 ab
Provide (GA), 5 ppm	3.7 abcd	1.3 ab
Provide (GA), 10 ppm	2.0 ab	2.0 ab
Provide (GA), 50 ppm	2.3 abc	1.3 ab
Provide (GA), 100 ppm	3.7 abcd	1.3 ab
Dropp (TDZ), 5 ppm	4.0 abcd	1.0 a
Dropp (TDZ), 10 ppm	4.0 abcd	1.7 ab
Dropp (TDZ), 50 ppm	6.0 cd	2.3 ab
Dropp (TDZ), 100 ppm	6.0 cd	2.7 ab
VBC-30101 (ABA), 250 ppm	3.0 abcd	1.7 ab
VBC-30101 (ABA), 500 ppm	4.7 abcd	2.3 ab
VBC-30101 (ABA), 1000 ppm	6.3 d	4.7 b
VBC-30101 (ABA), 125 ppm (drench)	3.3 abcd	3.0 ab
VBC-30101 (ABA), 250 ppm (drench)	5.7 bcd	4.7 b
VBC-30101 (ABA), 500 ppm (drench)	5.7 bcd	4.7 b
Water control	2.3 abc	1.3 ab

¹ 1=no phytotoxicity, 10=dead

² Days after treatment

³ Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys's HSD (p=0.05).

The plants with the best appearance consistently across varieties were those treated with the 250 ppm and 500 ppm rates of ABA sprays and the 125 ppm and 250 ppm drenches of ABA – all of

which increased the length of time until plant wilt in un-watered plants. The 5 ppm and 10 ppm rates of GA (with the exception of ‘Divine White’) and the water controls also resulted in consistently good appearance across all varieties.

Table 67. Days until plant collapse for four varieties not watered once put into storage room, Catlin, 2010

Treatment, Rate	Days to Wilt	
	New Guinea Impatiens ‘Divine White’	New Guinea Impatiens ‘Infinity White’
ABA, 250 ppm	11 a	14 ab
ABA, 500 ppm	11 a	16 a
ABA, 125 ppm (drench)	11 a	11 b
ABA, 250 ppm (drench)	13 a	9 b
Water control	8 a	12 b

Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys’s HSD (p=0.05).

For the storage test, some differences between the treatments were seen in the visual evaluations, though few were statistically significant (Table 67). The 250 ppm and 500 ppm rates of ABA sprays, the 125 ppm and 250 ppm drenches of ABA, and the 5 ppm and 10 ppm rates of GA (with the exception of ‘Divine White’), and the water controls were consistently of the better appearing plants in the trial. Applications of 50 and 100ppm of BA alone and BA+GA were consistently the least attractive plants in the trial. The results from the other treatments were somewhat mixed and mid-range compared to the best and worst listed above. The 5 ppm rate of BA resulted in higher visual ratings than the 10 ppm rate, and the 10 ppm rate of BA resulted in a lower rating than the control in all but ‘Divine White’, where it rated higher than the control. The 5 ppm and 10 ppm rates of BA+GA resulted in high ratings in both geranium varieties, but lower ratings in both impatiens. The 5 ppm and the 10 ppm rate of TDZ resulted in very poor ratings for ‘Divine White’, and mid-range ratings for ‘Maverick Pink’ and ‘Maestro Bright Red’. There were few treatments that were significantly different from the control plants in height, width, flower number, and bud number in any of the treatments (Table 69 and Table 70).

Due to the high heat and high light in the greenhouse, plants were particularly stressed before being placed in the storage boxes and the low light storage room. This resulted in Botrytis infection as well as root rot, and many plants were lost due to disease pressure, low light, and treatments. While numerous treatments showed an increase in visual attractiveness, under what conditions the plants became injured would need to be determined to guide growers to the best and safest application time and procedures.

Table 68. Average visual evaluation rating of BA, GA, BA+GA, TDZ, ABA treatments on two varieties of New Guinea impatiens, Catlin, 2010.

Treatment	Visual Evaluation (0 – 10)	
	New Guinea Impatiens 'Divine White'	New Guinea Impatiens 'Infinity White'
Maxcel (BA), 5 ppm	6.3 a	-- ^A
Maxcel (BA), 10 ppm	4.6 abc	5.9 a
Maxcel (BA), 50 ppm	2.1 bc	6.2 a
Maxcel (BA), 100 ppm	1.3 c	--
Fascination (BA+GA), 5 ppm	4.0 abc	--
Fascination (BA+GA), 10 ppm	1.2 c	4.3 abc
Fascination (BA+GA), 50 ppm	0.8 c	2.1 c
Fascination (BA+GA), 100 ppm	0.8 c	2.3 bc
Provide (GA), 5 ppm	3.9 abc	6.2 a
Provide (GA), 10 ppm	6.0 a	5.1 abc
Provide (GA), 50 ppm	7.0 a	--
Dropp (TDZ), 5 ppm	1.6 c	--
Dropp (TDZ), 10 ppm	1.0 c	--
VBC-30101 (ABA), 250 ppm	5.7 ab	5.1 abc
VBC-30101 (ABA), 500 ppm	6.0 a	5.6 ab
VBC-30101 (ABA), 125 ppm (drench)	5.8 ab	--
VBC-30101 (ABA), 250 ppm (drench)	5.8 ab	--
Water control	5.5 ab	5.9 ab

^A indicates plant was dead and removed from trial

^b indicates rate was not tested.

^c (0=unsalable, 10=highly attractive).

Column with similar letters are not significantly different according to Kramer-adjusted Tukey's HSD (p=0.05).

Table 69. New Guinea Impatiens ‘Divine White’ height, width, flower number, and bud number of plant growth regulator treatments, Catlin, 2010.

Treatment	New Guinea Impatiens ‘Divine White’									
	Height (in)			Width (in)		Flower No.			Bud No.	
	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27
BA, 5 ppm	10.6 ab	8.8 a	9.5 a	14.4 a	16.9 a	0.3 ab	0 a	0 a	23.8 abcd	0 b
BA, 10 ppm	9.8 ab	10.8 a	10.7 a	12.9 a	15.0 a	0.2 ab	0 a	0 a	20.7 abcd	2.7 ab
BA, 50 ppm	7.9 ab	11.0 a	10.5 a	14.3 a	14.3 a	0 b	0 a	0 a	28.2 abcd	0 b
BA, 100 ppm	8.6 ab	.	.	13.6 a	.	0 b	.	.	19.3 abcd	.
BA+GA, 5 ppm	9.8 ab	10.3 a	10.8 a	13.0 a	14.5 a	0 b	0 a	0 a	18.8 abcd	0 b
BA+GA, 10 ppm	8.6 ab	8.0 a	.	12.5 a	.	0 b	0 a	.	9.3 d	.
BA+GA, 50 ppm	8.9 ab	.	.	14.2 a	.	0 b	.	.	12.5 bd	.
BA+GA, 100 ppm	5.9 b	.	.	11.5 a	.	0 b	.	.	24.5 abcd	.
GA, 5 ppm	10.3 ab	10.2 a	9.7 a	14.8 a	13.7 a	0 b	0 a	0 a	11.0 cd	0 b
GA, 10 ppm	11.5 a	12.8 a	12.4 a	13.0 a	16.7 a	0 b	0 a	0 a	10.3 d	0 b
GA, 50 ppm	10.9 a	12.9 a	12.3 a	14.9 a	16.8 a	0.5 ab	0.4 a	0.4 a	31.2 abc	1.0 b
TDZ, 5 ppm	7.7 ab	.	.	14.5 a	.	0.6 ab	.	.	32.8 ab	.
TDZ, 10 ppm	9.7 ab	.	.	15.2 a	.	2.4 a	.	.	36.6 a	.
ABA, 250 ppm	10.2 ab	10.7 a	12.0 a	13.3 a	.	2.0 ab	0 a	0.5 a	23.4 abcd	6.5 a
ABA, 500 ppm	10.8 ab	10.6 a	13.0 a	14.2 a	.	1.0 ab	0 a	0 a	24.8 abcd	0.5 b
ABA, 125 ppm (drench)	9.8 ab	11.0 a	9.9 a	13.4 a	.	0.2 ab	0 a	0 a	26.0 abcd	0.3 b
ABA, 250 ppm (drench)	11.0 a	11.8 a	12.2 a	13.7 a	.	0.3 ab	0.5 a	1.0 a	21.3 abcd	0.7 b
Water control	10.1 ab	11.2 a	11.3 a	14.3 a	.	0.7 ab	0 a	0 a	25.2 abcd	0.7 b

^A indicates that plant was dead and removed from trial.

^B indicates rate was not tested. .

Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys’s HSD (p=0.05). (Columns with no letters indicate that there were not enough data to analyze.)

Table 70. New Guinea Impatiens ‘Infinity White’ height, width, flower number, and bud number of plant growth regulator treatments, Catlin, 2010.

Treatment	New Guinea Impatiens ‘Infinity White’									
	Height (in)			Width (in)		Flower No.			Bud No.	
	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27	Jul 13	Jul 20	Jul 27	Jul 13	Jul 27
Maxcel (BA), 5 ppm	-- ^B	--	--	--	--	--	--	--	--	--
Maxcel (BA), 10 ppm	6.1 abcd	5.8 ab	6.0 abc	9.1 ab	9.8 ab	0 a	0	0	7.5 a	0
Maxcel (BA), 50 ppm	6.1 abcd	6.5 ab	6.8 ab	9.2 ab	10.5 a	0.2 a	0	0	9.7 a	0
Maxcel (BA), 100 ppm	--	--	--	--	--	--	--	--	--	--
Fascination (BA+GA), 5 ppm	--	--	--	--	--	--	--	--	--	--
Fascination (BA+GA), 10 ppm	6.3 abc	7.0 ab	6.0 abc	9.4 ab	8.9 ab	0 a	0	0	7.7 a	0
Fascination (BA+GA), 50 ppm	6.6 ab	.	.	8.9 ab	.	0 a	.	.	6.7 a	.
Fascination (BA+GA), 100 ppm	7.6 a	.	.	9.5 ab	.	0 a	.	.	3.5 a	.
Provide (GA), 5 ppm	6.6 ab	7.7 a	7.2 a	10.0 a	10.6 a	0 a	0	0	5.0 a	0
Provide (GA), 10 ppm	6.3 ab	6.5 ab	6.3 abc	8.8 ab	9.9 ab	0 a	0	0	3.5 a	0
Provide (GA), 50 ppm	--	--	--	--	--	--	--	--	--	--
Dropp (TDZ), 5 ppm	--	--	--	--	--	--	--	--	--	--
Dropp (TDZ), 10 ppm	3.8 de	5.0 b	4.0 c	7.5 b	6.4 b	0 a	0	0	6.4 a	0
VBC-30101 (ABA), 250 ppm	4.6 cde	4.8 b	5.0 bc	7.9 ab	9.3 ab	0 a	0	0	4.8 a	0
VBC-30101 (ABA), 500 ppm	--	--	--	--	--	--	--	--	--	--
VBC-30101 (ABA), 125 ppm (drench)	--	--	--	--	--	--	--	--	--	--
VBC-30101 (ABA), 250 ppm (drench)	--	--	--	--	--	--	--	--	--	--
Water control	5.5 bcde	5.6 ab	5.8 abc	8.5 ab	10.5 a	0 a	0	0	10.2 a	0

^A indicates that plant was dead and removed from trial.^B indicates rate was not tested. .

Means within a column with similar letters are not significantly different according to Kramer-adjusted Tukeys’s HSD (p=0.05). Columns with no letters indicate that there were not enough data to analyze.

Comparative Efficacy on Poinsettia (Poinsettia pulcherrima)



Two researchers conducted experiments to determine whether the application of plant growth regulators prior to crop finish enhanced plant quality and improved shelf life of poinsettia cultivars after simulated shipping. In 2006, Pemberton examined four products: Fascination, Maxcel and Provide applied at 100 ppm and a standard EthylBloc at 1 ppm. There were no differences between EthylBloc and the untreated control which had the best performance rating. The PGR's Fascination, Maxcel and Provide either did not affect or decreased plant quality and shelf life of the 4 cultivars studied. In 2007, Reid conducted a trial to determine the effect of five products: Fascination, Maxcel and Provide applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. Of these, TDZ showed considerable promise as a means of improving the postharvest life of poinsettias. For all characteristics examined, there was a general improvement in plants treated with TDZ. Maxcel sometimes resulted in a beneficial effect, but this was variable, depending on variety and plant characteristic examined. This variability presumably reflects differences in the rate of metabolism of this compound. Overall, Argylene, Fascination, Maxcel and Provide produced no significant postharvest benefits in poinsettias.

Pemberton 2006

In 2006, Pemberton conducted an experiment to determine effect of four products on shelf life of poinsettia cultivars 'Enduring Pink', Freedom Early Red', 'Monet Twilight' and 'White Star'. Fascination, Maxcel and Provide were applied at 100 ppm and the standard EthylBloc at 1 ppm. Plant performance was assessed with a rating scale of 1 (worst) to 10 (best) using parameters including flowering, height, and uniformity of growth and flowering. Bract phytotoxicity was rated on each evaluation date after shipping with 1 = slight, 2 = moderate, and 3 = severe. Bract color was rated on the last evaluation date with 1 = normal color, 2 = a moderate change in color which appeared as greening on the white cultivar, development of a darker pink with some greening on the Monet cultivar, a darkening on the red cultivar, and a slight fading on the pink cultivar, and 3 = a strong color change as described in 2. Flower (cyathium) stage was noted at each evaluation date with 1 = tight bud for all cyathia, 2 = anthesis of at least one cyathium in the majority of inflorescences on the plant, and 3 = anthesis of the majority of cyathia in each inflorescence on the plant.

Results for the different cultivars are shown in Table 71 to Table 74. There were no differences between EthylBloc and the untreated control which had the best performance rating. By 15 DAT, Fascination, Maxcel and Provide either had no effect or were deleterious when considering postharvest performance characteristics in comparison to the untreated control. The evaluation was thus terminated. MaxCel reduced performance rating for 'Monet Twilight' and 'Freedom Early Red' due to a phytotoxic response which was manifested as a burn on the bracts. Fascination and ProVide (GA₄₊₇ containing products) caused a stretching of the internodes within the inflorescences of each cultivar which made the plants unsightly. ProVide also accelerated cyathia development on 'White Star'. The 6-BA containing products Fascination and Maxcel also caused greening of 'White Star' bracts.

Table 71. Effect of several PGR's on the Postharvest Performance of Poinsettia (*Poinsettia pulcherrima*) 'Enduring Pink', Pemberton, 2006.

Treatment	Evaluations			
	11/21/06 ^y	11/23/06	11/28/06	12/5/06
Performance Rating				
Fascination 100 ppm	9.5	9.5	9.3 c	7.8 b
MaxCel 100 ppm	9.8	9.8	9.7 abc	7.7 b
ProVide 100 ppm	10.0	10.0	9.8 ab	8.3 b
EthylBloc 1 ppm	9.5	9.5	9.5 bc	9.7 a
Untreated	9.8	9.8	10.0 a	9.5 a
ANOVA	NS	NS	*	**
Flower Stage				
Fascination 100 ppm	1.3	1.5	2.3	3.0
MaxCel 100 ppm	1.2	1.7	2.3	3.0
ProVide 100 ppm	1.3	1.7	2.5	3.0
EthylBloc 1 ppm	1.5	1.8	2.7	3.0
Untreated	1.3	1.8	2.7	3.0
ANOVA	NS	NS	NS	NS
Bract Phytotoxicity Rating				
Fascination 100 ppm		1.0	1.0	1.0
MaxCel 100 ppm		1.0	1.0	1.5
ProVide 100 ppm		1.0	1.0	1.0
EthylBloc 1 ppm		1.0	1.0	1.0
Untreated		1.0	1.0	1.0
ANOVA		NS	NS	NS
Bract Color Rating				
Fascination 100 ppm				1.0
MaxCel 100 ppm				1.0
ProVide 100 ppm				1.0
EthylBloc 1 ppm				1.2
Untreated				1.0
ANOVA				NS

^y Fascination, Maxcel and Provide applied 11/20/06, EthylBloc applied 11/21/06.

Table 72. Effect of several PGR's on the Postharvest Performance of Poinsettia (*Poinsettia pulcherrima*) 'Freedom Early Red', Pemberton, 2006.

Treatment	Evaluations			
	11/21/06 ^y	11/23/06	11/28/06	12/5/06
Performance Rating				
Fascination 100 ppm	10.0	10.0 a	10.0 a	6.7 bc
MaxCel 100 ppm	10.0	9.3 b	7.8 b	6.3 c
ProVide 100 ppm	10.0	10.0 a	10.0 a	8.2 ab
EthylBloc 1 ppm	10.0	10.0 a	10.0 a	8.8 a
Untreated	10.0	10.0 a	10.0 a	9.5 a
ANOVA	NS	**	**	**
Flower Stage				
Fascination 100 ppm	1.5	1.7	1.8	2.8
MaxCel 100 ppm	1.2	1.3	2.0	2.8
ProVide 100 ppm	1.5	1.5	2.2	2.8
EthylBloc 1 ppm	1.3	1.5	1.8	2.5
Untreated	1.2	1.5	2.0	2.8
ANOVA	NS	NS	NS	NS
Bract Phytotoxicity Rating				
Fascination 100 ppm		1.0 b	1.0 b	1.0 b
MaxCel 100 ppm		1.7 a	2.7 a	3.2 a
ProVide 100 ppm		1.0 b	1.0 b	1.0 b
EthylBloc 1 ppm		1.0 b	1.0 b	1.0 b
Untreated		1.0 b	1.0 b	1.0 b
ANOVA		**	**	**
Bract Color Rating				
Fascination 100 ppm				1.0 b
MaxCel 100 ppm				1.7 a
ProVide 100 ppm				1.0 b
EthylBloc 1 ppm				1.0 b
Untreated				1.0 b
ANOVA				**

^y Fascination, Maxcel and Provide applied 11/20/06, EthylBloc applied 11/21/06.

Table 73. Effect of several PGR's on the Postharvest Performance of Poinsettia (*Poinsettia pulcherrima*) 'Monet Twilight', Pemberton, 2006.

Treatment	Evaluation Date			
	11/21/06 ^y	11/23/06	11/28/06	12/5/06
Performance Rating				
Fascination 100 ppm	10.0	10.0 a	9.7 a	7.5 b
MaxCel 100 ppm	10.0	9.5 b	8.7 b	7.7 b
ProVide 100 ppm	10.0	10.0 a	9.8 a	7.0 b
EthylBloc 1 ppm	10.0	10.0 a	9.8 a	9.0 a
Untreated	10.0	10.0 a	9.8 a	9.2 a
ANOVA	NS	**	*	**
Flower Stage				
Fascination 100 ppm	1.0	1.0	1.8	2.8
MaxCel 100 ppm	1.0	1.0	2.0	2.8
ProVide 100 ppm	1.0	1.0	1.8	2.5
EthylBloc 1 ppm	1.0	1.0	7.8	2.8
Untreated	1.0	1.2	2.0	2.8
ANOVA	NS	NS	NS	NS
Bract Phytotoxicity Rating				
Fascination 100 ppm		1.0 b	1.3 b	1.0 b
MaxCel 100 ppm		1.5 a	2.2 a	2.0 a
ProVide 100 ppm		1.0 b	1.0 b	1.0 b
EthylBloc 1 ppm		1.0 b	1.0 b	1.0 b
Untreated		1.0 b	1.0 b	1.0 b
ANOVA		**	**	**
Bract Color Rating				
Fascination 100 ppm				2.0
MaxCel 100 ppm				2.0
ProVide 100 ppm				1.8
EthylBloc 1 ppm				1.8
Untreated				2.0
ANOVA				NS

^y Fascination, Maxcel and Provide applied 11/20/06, EthylBloc applied 11/21/06.

Table 74. Effect of several PGR's on the Postharvest Performance of Poinsettia (*Poinsettia pulcherrima*) 'White Star', Pemberton, 2006.

Treatment	Evaluation Date			
	11/21/06 ^y	11/23/06	11/28/06	12/5/06
Performance Rating				
Fascination 100 ppm	9.3	9.3	9.5	6.7 d
MaxCel 100 ppm	9.5	9.5	9.5	6.8 cd
ProVide 100 ppm	9.7	9.7	9.8	7.8 bc
EthylBloc 1 ppm	9.3	9.3	9.7	8.8 ab
Untreated	9.2	9.2	10.0	9.2 a
ANOVA	NS	NS	NS	**
Flower Stage				
Fascination 100 ppm	1.0	1.0	1.0	1.7 b
MaxCel 100 ppm	1.0	1.0	1.3	1.8 b
ProVide 100 ppm	1.2	1.2	1.3	2.8 a
EthylBloc 1 ppm	1.0	1.0	1.2	2.2 b
Untreated	1.0	1.0	1.3	2.2 b
ANOVA	NS	NS	NS	*
Bract Phytotoxicity Rating				
Fascination 100 ppm		1.0	1.3	1.7
MaxCel 100 ppm		1.0	1.5	1.8
ProVide 100 ppm		1.0	1.2	1.2
EthylBloc 1 ppm		1.0	1.3	1.3
Untreated		1.0	1.0	1.2
ANOVA		NS	NS	NS
Bract Color Rating				
Fascination 100 ppm				2.0 b
MaxCel 100 ppm				3.0 a
ProVide 100 ppm				1.0 c
EthylBloc 1 ppm				1.2 c
Untreated				1.2 c
ANOVA				**

^y Fascination, Maxcel and Provide applied 11/20/06, EthylBloc applied 11/21/06.

Reid 2007

In 2007, Reid conducted an experiment to determine the effect of five products on shelf life of four poinsettia cultivars 'Hot Pink', 'Premium Red', 'Prestigo' and 'Yellow'. Fascination, Maxcel and Provide were applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. The number of yellow and dropped leaves and dropped bracts were counted throughout the experiment. The percentage of cyathea remaining on the plant was estimated. Any visible damage caused by the treatments was also recorded.

Leaf yellowing wasn't a problem in any of the four poinsettia varieties tested. Postharvest life was determined by loss of leaves, bracts, and cyathea. Effects of treatments were variable depending on the variety tested (Table 75 to

Table 77). In general, poinsettia plants treated with Argylene, Maxcel and TDZ dropped significantly less bracts than the untreated control and the other treatments (Table 75). Overall, plants treated with TDZ dropped significantly fewer leaves than the untreated control and other treatments (Table 76). After 3 weeks of display life, the control plants in all cultivars tested had lost most of their cyathea. In ‘Prestigo’, ‘Hot Pink’, and ‘Premium Red’, cyathea loss was significantly less in plants treated with TDZ, and sometimes reduced in those treated with Provide. In ‘Yellow’, only the Maxcel-treated plants showed a statistically (but not commercially) significant reduction in cyathea loss.

The TDZ treatments show considerable promise as a means of improving the postharvest life of poinsettia. For all characteristics examined, there was a general improvement in plants treated with TDZ. The superior performance of TDZ-treated plants during three weeks in the evaluation space presumably relates to the fact that TDZ is not metabolized. As might be expected, Maxcel treatment sometimes resulted in a beneficial effect, but this was variable, depending on cultivar and characteristic examined. This variability presumably reflects differences in the rate of metabolism of this compound. Overall, Argylene, Fascination, Maxcel and Provide provided no significant postharvest benefits in poinsettias.

Table 75. Effect of several PGR's on Bract Abscission of Poinsettia cultivars ‘Hot Pink’, Premium Red’, Prestigo’ and ‘Yellow’ (Poinsettia pulcherrima), Reid 2007.

Treatment	Number of Dropped Bracts at 23 DAT ^z			
	‘Hot Pink’	‘Premium Red’	‘Prestigo’	‘Yellow’
Argylene XM (STS) 0.5 mM	0.6 a	2.5 bc	0.6 a	2.0 a
Fascination (6-BA + GA ₄₊₇) 100 ppm	0.3 a	3.4cd	9.3 b	4.8 b
MaxCel (6-BA) 100 ppm	0.9 a	0.1 a	1.7 a	0.6 a
Provide (GA ₄₊₇) 100 ppm	1.1 a	4.1 cd	7.1 b	4.8 b
TDZ (Thidiazuron) 5 uM	0.1 a	0.8 ab	0.6 a	0.8 a
TDZ (Thidiazuron) 10 uM	0 a	0.3 a	1.4 a	0 a
Untreated	0.2 a	5.0 d	2.8 a	5.1 b

^z Means in the same column followed by the same letter are not significantly different.

Table 76. Effect of several PGR's on Leaf Abscission of Poinsettia cultivars ‘Hot Pink’, Premium Red’, Prestigo’ and ‘Yellow’ (Poinsettia pulcherrima), Reid 2007.

Treatment	Number of Dropped Leaves at 19 DAT			
	‘Hot Pink’	‘Premium Red’	‘Prestigo’	‘Yellow’
Argylene XM (STS) 0.5 mM	7.5 c	7.0 b	3.3 a	11.6 d
Fascination (6-BA + GA ₄₊₇) 100 ppm	5.4 abc	6.9 b	11.3 c	4.9 a
MaxCel (6-BA) 100 ppm	5.6 abc	3.7 a	5.8 ab	6.6 abc
Provide (GA ₄₊₇) 100 ppm	6.5 c	9.0 b	7.1 b	7.9 bc
TDZ (Thidiazuron) 5 uM	3.3 a	3.8 a	6.0 ab	5.8 ab
TDZ (Thidiazuron) 10 uM	4.0 ab	3.3 a	6.1 ab	3.9 a
Untreated	6.1 bc	8.1 b	4.2 a	8.9 cd

Table 77. Effect of several PGR's on Cyathea Loss of Poinsettia cultivars 'Hot Pink', 'Premium Red', 'Prestigo' and 'Yellow' (Poinsettia pulcherrima), Reid 2007.

Treatment	Percentage of Cyathea Left at 23 DAT ^z			
	'Hot Pink'	'Premium Red'	'Prestigo'	'Yellow'
Argylene XM (STS) 0.5 mM	0 a	0 a	0 a	0 a
Fascination (6-BA + GA ₄₊₇) 100 ppm	0 a	0 a	15.0 ab	1.1 a
MaxCel (6-BA) 100 ppm	0 a	1.4 a	0 a	0 a
Provide (GA ₄₊₇) 100 ppm	8.0 ab	0 a	16.3 b	7.0 b
TDZ (Thidiazuron) 5 uM	44.0 c	30.0 b	25.0 b	0 a
TDZ (Thidiazuron) 10 uM	16.7 b	50.0 c	6.3 a	0 a
Untreated	1.7 a	7.5 a	0 a	1.3 a

^z Means in the same column followed by the same letter are not significantly different

Comparative Efficacy on Tulip (*Tulipa* sp.)

Research to determine effect on enhancing plant quality and improving shelf life of tulip cultivars after simulated shipping was conducted by two researchers. In 2007, Reid conducted a trial to determine the effect of five products: Fascination, Maxcel and Provide applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. Of these, TDZ increased flower longevity, greatly reduced leaf yellowing, and reduced scape elongation. It appears to be the only product worth further examination as a treatment for improving the postharvest life of tulips. Argylene had no positive effect on the tulip plants. Although Fascination and Provide had some beneficial effects (slight extension of flower life, and dramatic inhibition of leaf yellowing), they increased scape length that led to very undesirable scape bending.



Miller conducted a non-funded study to determine the effect of Fascination, Provide and ABG-3062 (6-BA) on shelf life of ‘Seadov’ tulip. Fascination was applied at 5, 10, 25, 50 and 100 ppm at these plant stages: ‘bud stage’, pots containing plants with full-colored or half-colored buds; ‘bloom stage’, pots with one- or 2-day old flowers and full-colored buds; or ‘full-bloom stage’, pots with five or more open flowers which had opened 1–4 days earlier. Plants were not subjected to simulated shipping before evaluation of shelf life. Regardless of plant stage, treatment with Fascination improved individual flower longevity and postproduction longevity in the range of concentrations tested, with BA being the main active ingredient providing these benefits. Fascination generally increased flower and gynoecium diameters only at the higher rates (50 and 100 ppm). Stem and leaf lengths were not affected by application timing or concentration of Fascination throughout the 2-week postproduction evaluation period although stem lengths tended to increase with higher concentration of Fascination.

Reid 2007

In 2007, Reid conducted an experiment to determine the effect of five products on shelf life of four tulip cultivars ‘Hot Pink’, ‘Premium Red’, ‘Prestigo’ and ‘Yellow’. Fascination, Maxcel and Provide were applied at 100 ppm, TDZ at 5 and 10 uM and Argylene at 0.5 mM. After treatment, plants were placed in cardboard boxes and moved to a room maintained at approximately 20 °C to simulate shipping for 2 days in darkness. These were then placed on display in a simulated interior environment for evaluation of their postharvest performance. Number of dead flowers, scape length, number of bent scapes and change in leaf color were recorded.

The products had different effects on senescence of the different cultivars (Table 78). Apart from an increased number of dead flowers on plants treated with Argylene, products did not affect longevity of ‘Red Present’ flowers. No product affected ‘Hollandia’ flowers. ‘Pink Impression’ treated with Provide and TDZ had significantly less dead flowers than the Argylene, Fascination and untreated control. On ‘Purple Prince’, Provide and TDZ at the higher rate reduced number of dead flowers compared to Argylene, Maxcel and the untreated control. The effect of products on scape length and number of bent scapes, which is correlated with scape elongation, again depended on the cultivars (Table 80). In general, Fascination, Maxcel and Provide increased scape length while TDZ decreased it. Fascination and Provide increase the number of bent scapes in ‘Hollandia’, a cultivar that is more susceptible to scape bending.

During the display life starting at 2 DAT, the leaf color in all untreated and Argylene treated cultivars changed to lighter green and lost chlorophyll (as indicated by a decrease in hue angle). The other treatments maintained a relatively stable leaf color in all cultivars over the 12 days of evaluation period. Figure 2 shows the average hue angle data for all cultivars.

TDZ increased flower longevity, greatly reduced leaf yellowing, and reduced scape elongation. It appears to be the only product worth further examination as a treatment for improving the postharvest life of tulips. Argylene had no positive effect on the tulip plants. Although Fascination and Provide had some beneficial effects (slight extension of flower life, and dramatic inhibition of leaf yellowing), their effects on scape elongation led to very undesirable scape bending.

Table 78. Effect of several PGR's on Flower Longevity of Tulip cultivars 'Hollandia', 'Pink Impression', 'Purple Prince' and 'Red Present' (*Tulipa* sp.), Reid 2007.

Treatment	Number of Dead Flowers ^z			
	'Hollandia' 7 DAT	'Pink Impression' 7 DAT	'Purple Prince' 9 DAT	'Red Present' 7 DAT
Argylene XM (STS) 0.5 mM	0 a	1.7 c	1.1 c	2.9 b
Fascination (6-BA + GA ₄₊₇) 100 ppm	0.3 a	0.7 b	0.4 ab	2.0 a
MaxCel (6-BA) 100 ppm	0.2 a	0.4 ab	1.0 c	2.2 ab
Provide (GA ₄₊₇) 100 ppm	0.3 a	0.1 a	0.1 a	1.9 a
TDZ (Thidiazuron) 5 uM	0 a	0 a	0.5 abc	1.8 a
TDZ (Thidiazuron) 10 uM	0.2 a	0 a	0.2 a	1.5 a
Untreated	0.3 a	0.9 b	0.8 bc	2.3 ab

^z Means in the same column followed by the same letter are not significantly different.

Figure 79. Average Leaf Color Change, expressed as Hue Angle Data, of four Tulip cultivars 'Hollandia', 'Pink Impression', 'Purple Prince' and 'Red Present' (*Tulipa* sp.), Reid 2007.

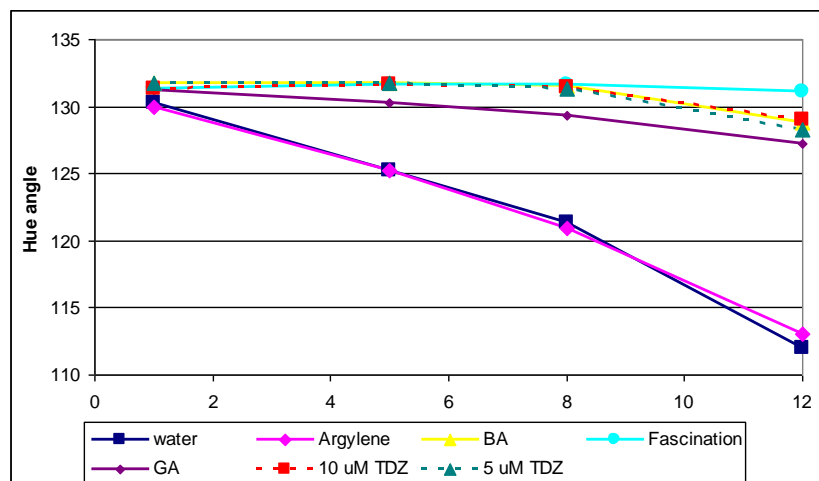


Table 80. Effect of several PGR's on Scape Length and Number of Bent Scapes of Tulip cultivars 'Hollandia', 'Pink Impression', 'Purple Prince' and 'Red Present' (*Tulipa sp.*), Reid, 2007.

Treatment	Scape Length (cm) at 5 DAT ^z				Number of Bent Scapes per pot			
	'Hollandia' 7 DAT	'Pink Impression' 7 DAT	'Purple Prince' 9 DAT	'Red Present' 7 DAT	'Hollandia' 7 DAT	'Pink Impression' 7 DAT	'Purple Prince' 9 DAT	'Red Present' ^y 7 DAT
Argylene XM (STS) 0.5 mM	29.7 ab	44.1 b	33.1 ab	23.3 a	0.8 a	2.1 a	1.3 c	-
Fascination (6-BA + GA ₄₊₇) 100 ppm	33.9 c	44.7 bc	35.7 c	24.7 ab	2.2 b	1.9 a	0.1 a	-
MaxCel (6-BA) 100 ppm	29.9 b	44.9 bc	33.9 b	24.2 ab	0.8 a	1.5 a	0 a	-
Provide (GA ₄₊₇) 100 ppm	34.3 c	45.9 c	39.2 d	25.5 b	2.4 b	1.8 a	0.2 a	-
TDZ (Thidiazuron) 5 uM	27.8 a	42.0 a	32.1 a	24.1 ab	1.0 a	1.8 a	0 a	-
TDZ (Thidiazuron) 10 uM	27.7 a	41.2 a	32.0 a	23.6 a	0.8 a	2.5 a	0.2 a	-
Untreated	28.9 ab	43.7 b	33.0 ab	23.5 a	0.7 a	1.3 a	0.7 b	-

^z Means in the same column followed by the same letter are not significantly different.

^y Tulips stayed short and their scapes didn't bend

Miller 2007

Miller conducted a non-funded study to determine the effect of Fascination, Provide and ABG-3062 (6-BA) on shelf life of ‘Seadov’ tulip. Fascination was applied at 5, 10, 25, 50 and 100 ppm at these plant stages: ‘bud stage’, pots containing plants with full colored or half-colored buds; ‘bloom stage’, pots with one- or 2-day old flowers and full-colored buds; or ‘full-bloom stage’, pots with five or more open flowers which had opened 1–4 days earlier. To verify which active ingredient in Fascination was responsible for the effects, Fascination, Provide and ABG-3062 at 10 ppm were applied at the full bloom stage. Plants were not subjected to simulated shipping in this study. Plants were moved to a simulated consumer environment the day after treatment and postproduction quality and longevity evaluated. Flower longevity, stem and leaf lengths, flower and gynoecium diameters were recorded.

Regardless of plant stage, treatment with Fascination improved individual flower longevity and postproduction longevity in the range of concentrations tested, with 6-BA identified as the main active ingredient in the mixture. At bud stage application, postproduction quality was improved with higher doses of Fascination. Fascination had a strong effect on enhancing flower longevity when sprayed at the mature (fully colored) bud stage, and a lesser effect when applied to immature (green) buds. When applied at bloom stage, however, concentrations over 50 ppm reduced individual flower and postproduction longevity relative to lower concentrations as a result of undesirable hyper-opening of older flowers and greatly stimulated gynoecium growth. For all flower ages, concentrations as low as 10 ppm significantly increased tulip flower longevity. Fascination generally increased flower and gynoecium diameters only at the higher rates (50 and 100 ppm). Stem and leaf lengths were not affected by application timing or concentration of Fascination throughout the 2-week postproduction evaluation period although stem lengths tended to increase with higher concentration of Fascination.

Efficacy Summary by Product

Argylene (Sodium silver thiosulfate)

Argylene provided mixed effects in 1 geranium trial, increasing leaf yellowing in ‘Tutti Frutti’ and decreasing leaf abscission in ‘Tango’. Similarly in one New Guinea impatiens trial, it reduced flower bud abscission but resulted in damaged flowers. Overall, it provided no significant postharvest benefits in one poinsettia and one tulip trial.

EthylBloc (1-MCP)

EthylBloc generally had no effect on 5 geranium, 1 impatiens and 1 poinsettia trials probably because plants were not specifically ethylene-stressed after the EthylBloc application; in the absence of ethylene EthylBloc often shows no effect.

ABG-3062/Configure/Exilis Plus/MaxCel (6-Benzyladenine)

Although not consistent in all trials, Maxcel and Exilis Plus at 100 ppm caused significant injury that negatively affected plant quality and shelf life of various geranium cultivars. The extent of phytotoxicity varied from none to significant depending on the cultivar. At 50 ppm, these products showed no phytotoxicity and improved shelf life in one trial. In another trial, Configure at 2.5, 5 and 10 ppm caused no injury but did not improve shelf life. On New Guinea impatiens, Maxcel had no effect on 4 cultivars in one trial. In another trial with 4 cultivars, it generally increased flower bud numbers but also increased abscission. In poinsettia, Maxcel either did not affect or decreased plant quality and shelf life of the 4 cultivars studied in one trial. In another trial, it provided no consistent postharvest benefits on 4 cultivars. On tulip, Maxcel at 100 ppm had no effect on 4 cultivars in one trial. However in another trial, ABG-3062 increased postproduction longevity of ‘Seadov’ tulip and was judged to be the main ingredient that provided the positive effects from Fascination (6-BA + GA₄₊₇) applied at 5, 10, 25, 50 and 100 ppm.

Fascination/Fresco (6-Benzyladenine + Gibberellins A₄ + A₇)

Although not consistent in all trials, Fascination and Fresco at 100 ppm caused significant injury that negatively affected plant quality and shelf life of various geranium cultivars; researchers attributed the 6-BA component of this product to be main phytotoxic agent. In a trial where Fascination reduced leaf yellowing, resulting in higher visual quality, the GA₄₊₇ component was judged to be providing these positive effects. In a single experiment on Impatiens walleriana Fascination increased flower number, as well as, plant height for one variety. In two New Guinea impatiens trials two out of four researchers noted stretching and one noted increased flower bud and leaf abscission. The negative effect on height was attributed to the GA₄₊₇ component of Fascination. In poinsettia, Fascination either did not affect or decreased plant quality and shelf life of the 4 cultivars studied in one trial. In another trial, it provided no consistent postharvest benefits on 4 cultivars. In one tulip trial, Fascination had some beneficial effects (slight extension of flower life and dramatic inhibition of leaf yellowing) but it increased scape length that led to very undesirable scape bending. However in another trial, Fascination applied at 5, 10, 25, 50 and 100 ppm increased postproduction longevity of ‘Seadov’ tulip; the 6-BA component was the main ingredient that provided the positive effects. Overall, it did not significantly increase scape length.

NovaGib 10L/Provide (Gibberellins A₄ + A₇)

The GA₄₊₇ products (NovaGib and Provide) generally were not phytotoxic to geranium cultivars and had positive effects in most studies; however, they increased peduncle length at 100 ppm. Further research will be needed to determine concentrations and application details for maximum effectiveness. In a single experiment on *Impatiens walleriana* Fascination increased flower number, as well as, plant height for one variety. On New Guinea *impatiens*, Provide results varied among experiments. In one experiment increased flower bud and leaf abscission was observed with Provide while increased number of open flowers in another trial with Novagib. In two of the four trials involving GA products, increased plant height was noted which was considered unacceptable. In poinsettia, Provide either did not affect or decreased plant quality and shelf life of the 4 cultivars studied in one trial. In another trial, it resulted in no consistent postharvest benefits on 4 cultivars. In one tulip trial, Provide had some beneficial effects (slight extension of flower life and dramatic inhibition of leaf yellowing) but it increased scape length that led to very undesirable scape bending.

Dropp (Thidiazuron)

TDZ provided the most improved plant quality and shelf life in three of four geranium trials. A distinct delay in flowering was noted, suggesting that this product would need to be applied at the full color stage.

In one poinsettia trial and one tulip trial, TDZ showed the most considerable promise as a means of improving postharvest life. In the poinsettia trial, there was a general improvement in plants treated with TDZ. In the tulip trial, TDZ increased flower longevity, greatly reduced leaf yellowing, and reduced scape elongation. In one *impatiens* trial, TDZ generally increased flower bud abscission; a negative effect on shelf life. Results of studies on these crops suggest that TDZ is a most promising product for improving shelf life in geranium, poinsettia and tulip.

Phytotoxicity

No phytotoxicity was observed during these experiments with Argylene, EthylBloc, the GA₄₊₇ products NovaGib and Provide, and TDZ. Although not consistent in all trials, products containing 6-BA (Fascination/Fresco, Maxcel/Exilis Plus) at 100 ppm caused significant injury that negatively affected plant quality and shelf life of geranium cultivars. Fascination caused no injury on *impatiens*, poinsettia and tulip. Maxcel caused bract phytotoxicity on poinsettia but no injury on *impatiens* and tulip.

Table 81. Summary of Plant Growth Regulator Impact on Herbaceous Plants.

Note: Table entries are sorted by crop Latin name. Only those trials with research reports received by 1/31/2011 are listed below.

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 3: Simulated Shipping: performance rating was higher for ABA (6.2) than untreated (5.8) but not significantly different at 100 ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: No significant improvement on shelf life at 100ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual shipping: no significant effect at 100 ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 4: Actual Shipping: no significant effect on shelf life with 100 ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 3: Simulated Shipping: no significant effect on shelf life at 100 ppm	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 4: Actual Shipping: significant improvement in shelf life with 100ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual Shipping: no significant effect at 100 ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 3: Simulated Shipping: Significant improvement on shelf life with 100 ppm compared to the untreated control.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant improvement on shelf life at 100 ppm.	20100712a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Drench	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Foliar	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. Significant phytotoxicity with 1000 ppm foliar application. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) I. 'Sonic Flame'	Greenhouse	Reid	2008	Foliar	50 pm was optimal in extending the postproduction life by 5 days at 20C in the absence of irrigation.	20100929b.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Drench	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Foliar	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. Significant phytotoxicity with 1000 ppm foliar application. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Lavender'	Greenhouse	Reid	2008	Foliar	100 ppm ABA reduced the number of flower buds that opened during the 4-week display life and failed to prevent leaf wilting on plants that were not irrigated during their display life.	20100929b.pdf
27844	ABA (Synthetic abscisic acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sweet Cherry'	Greenhouse	Reid	2008	Foliar	ABA treatment (50 and 100ppm) maintained leaf appearance, delayed wilting and improved tolerance to water deficit when irrigation was withheld. ABA treatment also reduced the number of flower buds that opened during the 4-week display life.	20100929b.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Drench	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Foliar	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. Significant phytotoxicity with 1000 ppm foliar application. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Drench	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Foliar	Length of time to wilt was increased with 250 and 500 ppm compared to unwatered control. Significant phytotoxicity with 1000 ppm foliar application. No significant differences for other parameters 250 and 500ppm rates.	20101102a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Drench or Foliar	No or little improvement of postharvest quality at 125, 250 and 500 ppm applied drench or at 250, 500 and 1000 ppm applied foliar.	20091224a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Pemberton	2008	Foliar	No significant effect on shelf life at 100 ppm.	20100104a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Reid	2008	Foliar	Treatment with 50 and 100 ppm reduced the number of yellow and dead leaves, and maintained leaf appearance.	20100929b.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Drench or Foliar	No improvement of postharvest quality at 125, 250 and 500 ppm applied drench or at 250, 500 and 1000 ppm applied foliar.	20091224a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Pemberton	2008	Foliar	No significant effect on shelf life at 100 ppm.	20100104a.pdf
27843	ABA (Synthetic abscisic acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Reid	2008	Foliar	Treatment with 50 and 100 ppm reduced the number of yellow and dead leaves, and maintained leaf appearance.	20100929b.pdf
26986	Argylene XM (Sodium Silver Thiosulfate)	Poinsettia (Euphorbia pulcherrima) 'Hot Pink'	Greenhouse	Reid	2006	Sprench	No significant increase in shelf life at 0.5 mM	20070719a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
26986	Argylene XM (Sodium Silver Thiosulfate)	Poinsettia (Euphorbia pulcherrima) 'Premium Red'	Greenhouse	Reid	2006	Foliar	Less dropped bracts but no change in leaf drop and cyathea loss at 0.5 mM	20070719a.pdf
26986	Argylene XM (Sodium Silver Thiosulfate)	Poinsettia (Euphorbia pulcherrima) 'Prestigo'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 0.5 mM	20070719a.pdf
26986	Argylene XM (Sodium Silver Thiosulfate)	Poinsettia (Euphorbia pulcherrima) 'Yellow'	Greenhouse	Reid	2006	Sprench	Less dropped bracts but no change in leaf drop and cyathea loss at 0.5 mM	20070719a.pdf
27625	Argylene XM (Sodium Silver Thiosulfate)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Jewels Red'	Greenhouse	Reid	2007	Sprench	Reduced flower bud abscission but caused significant flower injury at 0.5 mM	20071220l.pdf
27625	Argylene XM (Sodium Silver Thiosulfate)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Pink'	Greenhouse	Reid	2007	Sprench	Reduced flower bud abscission but caused significant flower injury at 0.5 mM	20071220l.pdf
27625	Argylene XM (Sodium Silver Thiosulfate)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Violet'	Greenhouse	Reid	2007	Sprench	Significant flower injury at 0.5 mM	20071220l.pdf
27625	Argylene XM (Sodium Silver Thiosulfate)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'White'	Greenhouse	Reid	2007	Sprench	Significant flower injury at 0.5 mM	20071220l.pdf
27624	Argylene XM (Sodium Silver Thiosulfate)	Geranium (Pelargonium sp.) 'Tango' (Zonal)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission but not yellowing at 0.5 mM	20071220k.pdf
27624	Argylene XM (Sodium Silver Thiosulfate)	Geranium (Pelargonium sp.) 'Tutti Frutti' (Ivy)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission and yellowing at 0.5 mM	20071220k.pdf
26985	Argylene XM (Sodium Silver Thiosulfate)	Tulip (Tulipa sp.) 'Hollandia'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 0.5 mM	20070719b.pdf
26985	Argylene XM (Sodium Silver Thiosulfate)	Tulip (Tulipa sp.) 'Pink Impression'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 0.5 mM	20070719b.pdf
26985	Argylene XM (Sodium Silver Thiosulfate)	Tulip (Tulipa sp.) 'Purple Prince'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 0.5 mM	20070719b.pdf
26985	Argylene XM (Sodium Silver Thiosulfate)	Tulip (Tulipa sp.) 'Red Present'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 0.5 mM	20070719b.pdf
27754	EthylBloc (1-MCP)	Poinsettia (Euphorbia pulcherrima) 'Enduring Pink'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080207c.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
27754	EthylBloc (1-MCP)	Poinsettia (Euphorbia pulcherrima) 'Freedom Early Red'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080207c.pdf
27754	EthylBloc (1-MCP)	Poinsettia (Euphorbia pulcherrima) 'Monet Twilight'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080207c.pdf
27754	EthylBloc (1-MCP)	Poinsettia (Euphorbia pulcherrima) 'White Star'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080207c.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Electric Orange'	Greenhouse	Chen	2008	Fumigation	No improvement in postharvest quality at 1 ppm.	20091223a.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Harmony Red'	Greenhouse	Chen	2009	Fumigation	No improvement in postharvest quality at 1 ppm.	20091223a.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Burgundy'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Cajun Bayou Mix'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Orange'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27698	EthylBloc (1-MCP)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Red'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) 'Freestyle Pink'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) 'Maverick Coral'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Chen	2007	Gas	Significantly prolonged bloom period at 1 ppm	20070317a.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Miller	2007	Gas	No significant effect on petal abscission or shelf life at 1 ppm	20080116k.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) P. x hortorum 'Tango'	Greenhouse	Chen	2007	Gas	Did not significantly prolong bloom period at 1 ppm	20070317a.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) P. X hortorum 'Tango'	Greenhouse	Miller	2007	Gas	No significant effect on petal abscission or shelf life at 1 ppm	20080116k.pdf
27697	EthylBloc (1-MCP)	Geranium (Pelargonium sp.) 'Survivor Red'	Greenhouse	Pemberton	2006	Gas	No significant effect on shelf life at 1 ppm	20080116l.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25947	Exilis Plus (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Electric Orange'	Greenhouse	Chen	2008	Foliar	No improvement in postharvest quality at 100 ppm.	20091223a.pdf
25947	Exilis Plus (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Harmony Red'	Greenhouse	Chen	2009	Foliar	Postharvest quality inferior to untreated Check at 100 ppm.	20091223a.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 10 and 25 ppm.	20091224a.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Chen	2007	Sprench	Slight injury but significantly prolonged bloom period at 50 and 100 ppm	20070317a.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) P. x hortorum 'Tango'	Greenhouse	Chen	2007	Sprench	Did not significantly prolong bloom period at 50 and 100 ppm	20070317a.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Drench	Experiment 1: Did not increase branching at 5, and 10 ppm drench applications.	20080116o.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Foliar	Experiment 1: Did not increase branching at 5, 10 and 20 ppm foliar applications.	20080116o.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Foliar	Experiment 2: No effect on lower leaf chlorosis or visual quality at 2.5, 5 and 10 ppm Configure.	20080116o.pdf
25862	Exilis Plus (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 10 and 25 ppm.	20091224a.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Endurig Pink'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Freedom Early Red'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Hot Pink'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Monet Twilight'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Premium Red'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Prestigo'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'White Star'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm; caused greening of bracts	20080207c.pdf
25873	Fascination (6-Benzyladenine + Gibberellic Acid)	Poinsettia (Euphorbia pulcherrima) 'Yellow'	Greenhouse	Reid	2006	Foliar	Less leaf drop but no change in dropped bracts and cyathea loss at 100 ppm	20070719a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping;no significant effect with 100 ppm.	20100712a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual shipping: no significant effect at 100 ppm for overall performance. Significant reduction in flower count in one out of ratings (2/11/09).	20100712a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 2: Actual Shipping;no significant effect at 100 ppm.	20100712a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant effect on shelf life at 100 ppm.	20100712a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Foliar	Crop injury ratings not significantly different from untreated. However, low visual ratings (unsalable) with 10, 50 and 100 ppm compared to control. Significantly reduced flower number occurred with 5, 10, 50 100 ppm 1WAT suggests flowering delay although counts were very low (0-2 flower) for all treatments. Reduced Height 1WAT with 100 ppm.	20101102a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Electric Orange'	Greenhouse	Chen	2008	Foliar	No improvement in postharvest quality at 100 ppm.	20091223a.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Harmony Red'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 100 ppm.	20091223e.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Foliar	Low visual ratings (unsalable) with 50 ppm compared to control. Significant increase in height 1 WAT with 100 ppm.	20101102a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Jewels Red'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Pink'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Flame'	Greenhouse	Reid	2008	Foliar	No improvement in shelf life over the control.	20100929b.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Lavender'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Burgundy'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm; increased plant height	20080116l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Cajun Bayou Mix'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Orange'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm; increased plant height	20080116l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Red'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm; increased plant height	20080116l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sweet Cherry'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Violet'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25944	Fascination (6-Benzyladenine + Gibberellic Acid)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'White'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Cascade Hot Pink'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Freestyle Pink'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm; slight injury (leaf burn)	20080116l.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Holiday Purple'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Foliar	No significant differences from untreated for growth parameters or visual ratings.	20101102a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maverick Coral'	Greenhouse	Pemberton	2006	Sprench	Moderate injury (leaf burn) at 100 ppm	20080116l.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Foliar	No significant differences from untreated for crop injury or growth parameters. Low visual ratings (unsalable) with 50 and 100 ppm.	20101102a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Foliar	Postharvest quality equal to untreated Check at 10, inferior at 25 ppm.	20091224a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Pemberton	2008	Foliar	Significantly reduced shelf life at 100 ppm; leaf and flower injury.	20100104a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Chen	2007	Sprench	Moderate to severe injury and reduced plant quality at 50 and 100 ppm	20070317a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Miller	2007	Foliar	Increased number of florets, shelf life at 100 ppm; slight injury (necrosis on receptacle and leaves, Kalanchoe-looking small florets)	20080116k.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) P. x hortorum 'Tango'	Greenhouse	Chen	2007	Sprench	Significant injury and reduced plant quality at 100, not at 50 ppm	20070317a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) P. X hortorum 'Tango'	Greenhouse	Miller	2007	Foliar	Increased number of florets, shelf life at 100 ppm; slight injury (leaf necrosis, Kalanchoe-looking small florets)	20080116k.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Drench	Experiment 1: Some increase in branching at 5 and 10 ppm drench applications.	20080116o.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Foliar	Experiment 1: No effect on branching at 5, 10 and 20 ppm foliar applications.	20080116o.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2007	Foliar	Experiment 2: Decreased lower leaf chlorosis and increased visual quality at 2.5, 5 and 10 ppm	20080116o.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Drench	No effect on lower leaf chlorosis or necrosis with 2.5 ppm.	20100308a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Foliar	Reduced number of chlorotic/necrotic leaves with 5 and 10 ppm applied at visible bud stage.	20100308a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 10 and 25 ppm.	20091224a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Pemberton	2008	Foliar	Significantly reduced shelf life at 100 ppm; leaf and flower injury.	20100104a.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Startrack Purple'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Startrack Violet'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Survivor Red'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm; slight injury (leaf burn)	20080116l.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Tango' (Zonal)	Greenhouse	Reid	2007	Sprench	Too phytotoxic at 100 ppm	20071220k.pdf
25859	Fascination (6-Benzyladenine + Gibberellic Acid)	Geranium (Pelargonium sp.) 'Tutti Frutti' (Ivy)	Greenhouse	Reid	2007	Sprench	Too phytotoxic at 100 ppm	20071220k.pdf
25866	Fascination (6-Benzyladenine + Gibberellic Acid)	Tulip (Tulipa sp.) 'Hollandia'	Greenhouse	Reid	2006	Foliar	Undesirable effect - increased scape length and bending at 100 ppm	20070719b.pdf
25866	Fascination (6-Benzyladenine + Gibberellic Acid)	Tulip (Tulipa sp.) 'Pink Impression'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf
25866	Fascination (6-Benzyladenine + Gibberellic Acid)	Tulip (Tulipa sp.) 'Purple Prince'	Greenhouse	Reid	2006	Foliar	Undesirable effect - increased scape length at 100 ppm	20070719b.pdf

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25866	Fascination (6-Benzyladenine + Gibberellic Acid)	Tulip (Tulipa sp.) 'Red Present'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Cascade Hot Pink'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Holiday Purple'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Foliar	No significant injury at 5 and 10, high at 50 and 100 ppm.	20091224a.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Foliar	No significant injury at 5 and 10, high at 50 and 100 ppm.	20091224a.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Startrack Purple'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25860	Fresco (Gibberellic Acid + 6-Benzyladenine)	Geranium (Pelargonium sp.) 'Startrack Violet'	Greenhouse	Chen	2006	Sprench	Moderate injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Enduring Pink'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Freedom Early Red'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm; significant injury (burn on bracts)	20080207c.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Hot Pink'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Monet Twilight'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm; significant injury (burn on bracts)	20080207c.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Premium Red'	Greenhouse	Reid	2006	Foliar	Lower bract and leaf drops, no change in cyathea loss at 100 ppm	20070719a.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Prestigo'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'White Star'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm; caused greening of bracts	20080207c.pdf

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25877	MaxCel (6-Benzyladenine)	Poinsettia (Euphorbia pulcherrima) 'Yellow'	Greenhouse	Reid	2006	Foliar	Less dropped bracts but no change in leaf drop and cyathea loss at 100 ppm	20070719a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: Performance ratings ranged from 9.5 down to 6.8 and were statistically lower than the untreated control on two out of five performance ratings. Flower count was significantly decreased on the last two ratings.	20100712a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual shipping: no significant effect at 100 ppm.	20100712a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 2: Actual Shipping: no significant effect at 100 ppm.	20100712a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant effect on shelf life at 100 ppm.	20100712a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Foliar	No significant differences in crop injury or growth parameters compared to control with 5, 10, 50, 100 ppm.	20101102a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Electric Orange'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 100 ppm.	20091223a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Harmony Red'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 100 ppm.	20091223e.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Foliar	No significant differences in crop injury or growth parameters compared to control with 5, 10, 50, 100 ppm.	20101102a.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Jewels Red'	Greenhouse	Reid	2007	Sprench	No significant effect at 100 ppm	20071220l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Pink'	Greenhouse	Reid	2007	Sprench	Increased flower bud abscission at 100 ppm	20071220l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Flame'	Greenhouse	Reid	2008	Foliar	No improvement in shelf life over the control.	20100929b.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Lavender'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Burgundy'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Cajun Bayou Mix'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Orange'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Red'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sweet Cherry'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Violet'	Greenhouse	Reid	2007	Sprench	Increased number and abscission of flower buds at 100 ppm	20071220l.pdf
25948	MaxCel (6-Benzyladenine)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'White'	Greenhouse	Reid	2007	Sprench	increased flower bud abscission at 100 ppm	20071220l.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Cascade Hot Pink'	Greenhouse	Chen	2006	Sprench	Number of flowers virtually similar to Untreated at 100 ppm	20070110e.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Freestyle Pink'	Greenhouse	Pemberton	2006	Sprench	Moderate injury (leaf burn) at 100 ppm	20080116l.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Holiday Purple'	Greenhouse	Chen	2006	Sprench	Number of flowers virtually similar to Untreated at 100 ppm	20070110e.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Foliar	No significant differences in crop injury or growth parameters compared to control with 5, 10, 50, 100 ppm.	20101102a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Coral'	Greenhouse	Pemberton	2006	Sprench	High injury (leaf burn) at 100 ppm	20080116l.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Foliar	No significant injury at 5 and 10, high at 50 and 100 ppm.	20091224a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Pemberton	2008	Foliar	Significantly reduced shelf life at 100 ppm; leaf and flower injury.	20100104a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Foliar	No significant differences in crop injury or growth parameters compared to control with 5, 10, 50, 100 ppm.	20101102a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Chen	2007	Sprench	Slight injury but significantly prolonged bloom period at 50 and 100 ppm	20070317a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Miller	2007	Foliar	Slight injury (bleached spots on open florets) and increased petal abscission at 100 ppm; no significant effect on shelf life	20080116k.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) P. x hortorum 'Tango'	Greenhouse	Chen	2007	Sprench	Did not significantly prolong bloom period at 50 and 100 ppm	20070317a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) P. X hortorum 'Tango'	Greenhouse	Miller	2007	Foliar	Slight injury (bleached spots on open florets) at 100 ppm; no significant effect on shelf life	20080116k.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Drench	No effect on lower leaf chlorosis or necrosis with 2.5 ppm.	20100308a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Foliar	No effect on lower leaf chlorosis or necrosis with 2.5, 5 and 10 ppm.	20100308a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Foliar	No significant injury at 5 and 10, moderate at 50 and 100 ppm.	20091224a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Pemberton	2008	Foliar	Significantly reduced shelf life at 100 ppm; leaf and flower injury.	20100104a.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Reid	2008	Foliar	Crop Injury at 100 ppm and accelerated leaf and flower senescence.	20100929b.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Startrack Purple'	Greenhouse	Chen	2006	Sprench	Number of flowers virtually similar to Untreated at 100 ppm	20070110e.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Startrack Violet'	Greenhouse	Chen	2006	Sprench	Number of flowers virtually similar to Untreated at 100 ppm	20070110e.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Survivor Red'	Greenhouse	Pemberton	2006	Sprench	Slight injury (leaf burn) at 100 ppm	20080116l.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Tango' (Zonal)	Greenhouse	Reid	2007	Sprench	Too phytotoxic at 100 ppm	20071220k.pdf
25863	MaxCel (6-Benzyladenine)	Geranium (Pelargonium sp.) 'Tutti Frutti' (Ivy)	Greenhouse	Reid	2007	Sprench	Too phytotoxic at 100 ppm	20071220k.pdf
25870	MaxCel (6-Benzyladenine)	Tulip (Tulipa sp.) 'Hollandia'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf
25870	MaxCel (6-Benzyladenine)	Tulip (Tulipa sp.) 'Pink Impression'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf
25870	MaxCel (6-Benzyladenine)	Tulip (Tulipa sp.) 'Purple Prince'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf
25870	MaxCel (6-Benzyladenine)	Tulip (Tulipa sp.) 'Red Present'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but no other positive effects at 100 ppm	20070719b.pdf

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25949	NovaGib (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Electric Orange'	Greenhouse	Chen	2008	Foliar	No improvement in postharvest quality at 100 ppm.	20091223a.pdf
25949	NovaGib (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Harmony Red'	Greenhouse	Chen	2009	Foliar	Postharvest quality inferior to untreated Check at 100 ppm.	20091223a.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Cascade Hot Pink'	Greenhouse	Chen	2006	Sprench	Slight injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Holiday Purple'	Greenhouse	Chen	2006	Sprench	Slight injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Chen	2008	Foliar	Postharvest quality equal to untreated Check at 10, inferior at 25, 50 and 100 ppm.	20091224a.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Chen	2007	Sprench	Did not prolong bloom period at 50 and 100 ppm	20070317a.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) P. x hortorum 'Tango'	Greenhouse	Chen	2007	Sprench	Significantly decreased bloom period at 50 and 100 ppm; increased plant growth and peduncle length at 100 ppm	20070317a.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Chen	2008	Foliar	Postharvest quality inferior to untreated Check at 10, 25, 50 and 100 ppm.	20091224a.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Startrack Purple'	Greenhouse	Chen	2006	Sprench	Slight injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25864	NovaGib (GA4+7)	Geranium (Pelargonium sp.) 'Startrack Violet;	Greenhouse	Chen	2006	Sprench	Slight injury at 100 ppm; less flowers than Untreated by 14 DAT	20070110e.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Enduring Pink'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Freedom Early Red'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Hot Pink'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Monet Twilight'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm	20080207c.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Premium Red'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Prestigo'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'White Star'	Greenhouse	Pemberton	2006	Foliar	Reduced shelf life at 100 ppm; accelerated cyathia development	20080207c.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25879	ProVide (GA4+7)	Poinsettia (Euphorbia pulcherrima) 'Yellow'	Greenhouse	Reid	2006	Foliar	No significant increase in shelf life at 100 ppm	20070719a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant effect with 100 ppm.	20100712a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual shipping: no significant effect at 100 ppm.	20100712a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 2: Actual Shipping: no significant effect at 100 ppm.	20100712a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant effect on shelf life at 100 ppm.	20100712a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Foliar	No significant differences in crop injury compared to control for 5, 10, 50 ppm. Small reduction in flower number 1 WAT for 5 and 10 ppm compared to control. Although (number of flowers overall very low 0-2).	20101102a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Foliar	No significant differences for crop injury ratings or growth parameters compared to control for 5, 10, 50 ppm.	20101102a.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Jewels Red'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Pink'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Flame'	Greenhouse	Reid	2008	Foliar	100ppm caused slight reduction in flower quality, judged as the number of open flowers on a plant.	20100929b.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Lavender'	Greenhouse	Reid	2008	Foliar	No appreciable benefit with 100ppm compared to control.	20100929b.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Burgundy'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm; increase plant height	20080116l.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Cajun Bayou Mix'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm	20080116l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Orange'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm; increased plant height	20080116l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Elfin Red'	Greenhouse	Pemberton	2006	Sprench	No significant effect on shelf life at 100 ppm; increased plant height	20080116l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sweet Cherry'	Greenhouse	Reid	2008	Foliar	100 ppm effectively maintained flower quality on 'Sweet Cherry' plants subjected to simulated shipping	20100929b.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Violet'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25950	ProVide (GA4+7)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'White'	Greenhouse	Reid	2007	Sprench	Unacceptable increase in flower bud and leaf abscission, and plant height at 100 ppm	20071220l.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Freestyle Pink'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm	20080116l.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Foliar	No significant differences for crop injury ratings or growth parameters compared to control for 5, 10, 50 ppm.	20101102a.pd
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Maverick Coral'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm	20080116l.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Foliar	No significant differences for crop injury ratings or growth parameters compared to control for 5, 10, 50 ppm.	20101102a.pd
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Pemberton	2008	Foliar	No significant effect on shelf life at 100 ppm.	20100104a.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Reid	2008	Foliar	Treatment with 100 ppm delayed senescence (reduced number of yellow/dead leaves) on plants exposed to simulated shipping and was effective in extending flowering display life.	20100929b.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) P. peltatum 'Tutti Frutti'	Greenhouse	Miller	2007	Foliar	Increased number of florets, size of inflorescence and shelf life at 100 ppm	20080116k.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) P. X hortorum 'Tango'	Greenhouse	Miller	2007	Foliar	Increased number of florets, size of inflorescence and shelf life at 100 ppm	20080116k.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Drench	Reduced number of chlorotic/necrotic leaves with 2.5 ppm applied 2 WAT.	20100308a.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Pinto Red'	Greenhouse	Runkle	2008	Foliar	Reduced number of chlorotic/necrotic leaves with 2.5, 5 and 10 ppm.	20100308a.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Pemberton	2008	Foliar	Slight reduction of shelf life at 100 ppm.	20100104a.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Reid	2008	Foliar	Treatment with 100 ppm delayed senescence (reduced number of yellow/dead leaves) on plants exposed to simulated shipping and was effective in extending flowering display life.	20100929b.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Survivor Red'	Greenhouse	Pemberton	2006	Sprench	Maintained performance and flower number longer at 100 ppm	20080116l.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Tango' (Zonal)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission and yellowing but caused unacceptable plant and flower scape elongation at 100 ppm	20071220k.pdf
25865	ProVide (GA4+7)	Geranium (Pelargonium sp.) 'Tutti Frutti' (Ivy)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission and yellowing but caused unacceptable plant and flower scape elongation at 100 ppm	20071220k.pdf
25872	ProVide (GA4+7)	Tulip (Tulipa sp.) 'Hollandia'	Greenhouse	Reid	2006	Foliar	Undesirable effect - increased scape length and bending at 100 ppm	20070719b.pdf
25872	ProVide (GA4+7)	Tulip (Tulipa sp.) 'Pink Impression'	Greenhouse	Reid	2006	Foliar	Increased flower life and reduced leaf yellowing but increased scape length at 100 ppm	20070719b.pdf
25872	ProVide (GA4+7)	Tulip (Tulipa sp.) 'Purple Prince'	Greenhouse	Reid	2006	Foliar	Increased flower life and reduced leaf yellowing but increased scape length at 100 ppm	20070719b.pdf
25872	ProVide (GA4+7)	Tulip (Tulipa sp.) 'Red Present'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing but increased scape length at 100 ppm	20070719b.pdf
26001	TDZ (Thidiazuron)	Poinsettia (Euphorbia pulcherrima) 'Hot Pink'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM, better at 5 uM; the only promising product	20070719a.pdf
26001	TDZ (Thidiazuron)	Poinsettia (Euphorbia pulcherrima) 'Premium Red'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM; the only promising product	20070719a.pdf
26001	TDZ (Thidiazuron)	Poinsettia (Euphorbia pulcherrima) 'Prestigo'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 uM, but not at 10 uM; the only promising product	20070719a.pdf
26001	TDZ (Thidiazuron)	Poinsettia (Euphorbia pulcherrima) 'Yellow'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM; the only promising product	20070719a.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant improvement on shelf life at 1 ppm.	20100712a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Light Lavender'	Greenhouse	Pemberton	2008	Foliar	Trial 2 Actual shipping: Significant reduction in performance rating on 2/11/09 and 2/19/09, as well as, decreased flower count on 2/11/09 at 1ppm.	20100712a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Sweet Cherry'	Greenhouse	Pemberton	2008	Foliar	Trial 2: Actual Shipping: significant decrease in performance rating and flower count.	20100712a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Super Sonic Flame'	Greenhouse	Pemberton	2008	Foliar	Trial 1: Simulated Shipping: no significant effect on shelf life at 1 ppm.	20100712a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Divine White'	Greenhouse	Catlin	2010	Foliar	High rates, 50 and 100 ppm caused significant crop injury. No differences in growth parameters observed for 5 and 10 ppm.	20101102a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Infinity White'	Greenhouse	Catlin	2010	Foliar	High rates, 50 and 100 ppm caused significant crop injury. No differences in growth parameters observed for 5 ppm. The 10ppm treatment displayed decreased width 2WAT.	20101102a.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Jewels Red'	Greenhouse	Reid	2007	Sprench	No significant effect at 5 and 10 uM	20071220l.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Pink'	Greenhouse	Reid	2007	Sprench	Increased flower bud abscission at 5 and 10 uM	20071220l.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Flame'	Greenhouse	Reid	2008	Foliar	No appreciable difference compared to control.	20100929b.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sonic Lavender'	Greenhouse	Reid	2008	Foliar	No appreciable benefit with 10 uml compared to control.	20100929b.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Sweet Cherry'	Greenhouse	Reid	2008	Foliar	10 uml effectively maintained flower quality on plants subjected to simulated shipping.	20100929b.pdf
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'Violet'	Greenhouse	Reid	2007	Sprench	Increased flower bud abscission at 5 and 10 uM	20071220l.pdf

PR #	Product (Active Ingredients)	Crop	Production Site	Researcher	Trial Year	Application Type	Results	File Name
26002	TDZ (Thidiazuron)	New Guinea Impatiens (Impatiens New Guinea hybrids) 'White'	Greenhouse	Reid	2007	Sprench	Increased number and abscission of flower buds at 5 and 10 uM	20071220l.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Maestro Bright Red'	Greenhouse	Catlin	2010	Foliar	High rates, 50 and 100 ppm caused significant crop injury. No differences in growth parameters observed for 5 and 10 ppm.	20101102a.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Catlin	2010	Foliar	Crop injury with 50 and 100 ppm. At 5 and 10 ppm no differences in visual ratings or growth parameters compared to control.	20101102a.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Pemberton	2008	Foliar	Significantly increased shelf life at 1 ppm.	20100104a.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Maverick Pink'	Greenhouse	Reid	2008	Foliar	No appreciable benefit from 10 uml compared to control.	20100929b.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Pemberton	2008	Foliar	No significant effect on shelf life at 1 ppm.	20100104a.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Ringo Salmon'	Greenhouse	Reid	2008	Foliar	Plants treated with 10umL exhibit a greater number of flowering spikes after 21 days of interior display than water controls and displayed fewer senescent leaves as compared to water control plants.	20100929b.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Tango' (Zonal)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission and yellowing at 5 and 10 uM; most promising product	20071220k.pdf
25999	TDZ (Thidiazuron)	Geranium (Pelargonium sp.) 'Tutti Frutti' (Ivy)	Greenhouse	Reid	2007	Sprench	Reduced leaf abscission and yellowing at 5 and 10 uM; most promising product	20071220k.pdf
26000	TDZ (Thidiazuron)	Tulip (Tulipa sp.) 'Hollandia'	Greenhouse	Reid	2006	Foliar	Reduced leaf yellowing and scape length at 5 and 10 uM; promising product	20070719b.pdf
26000	TDZ (Thidiazuron)	Tulip (Tulipa sp.) 'Pink Impression'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM; promising product	20070719b.pdf
26000	TDZ (Thidiazuron)	Tulip (Tulipa sp.) 'Purple Prince'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM; promising product	20070719b.pdf
26000	TDZ (Thidiazuron)	Tulip (Tulipa sp.) 'Red Present'	Greenhouse	Reid	2006	Foliar	Overall increase in shelf life at 5 and 10 uM; promising product	20070719b.pdf

Label Suggestions

Data accumulated through the IR-4 research program in 2006 and 2010 show rather variable results and not adequate at this time to consider registration of any of the products tested on any of the ornamental species studied.

Appendix 1: Protocols

Impact of various PGRs on shelf life of herbaceous ornamentals grown in pots.

Ornamental Protocol Number: 06-014

Objective: determine whether certain PGR materials increase the shelf-life of certain flowering, potted ornamentals

Experimental Design:

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: Minimum of 8 replications of 4 different varieties of crop species

Application Instructions: Foliar spray applications (srench) using 2 – 3 quarts solution per 100 sq ft. Maintain plants in greenhouse for 1 - 2 days. Then place them in boxes and keep in darkness for 48 hours to simulate shipping. Then place plants into conditions simulating a typical retail display facility (20°C 12 hours of fluorescent light, with watering as necessary). Evaluations will be made prior to simulated shipping, immediately after, and 7, 14, and 21 days after simulated shipping or until suitable relevant data cannot be collected, but no longer than 21 days.

Target Plant Species: Geranium, tulip, poinsettia, impatiens

Use Site: Greenhouse/Field Container

Evaluations: Flower number, visual quality on a scale of 0 to 10 (with 0 being unsaleable and 10 being highly attractive), and phytotoxicity (with 0 being no phytotoxicity and 10 being plant death). Please include photos of examples of untreated plants and any treated plants exhibiting responses to treatments.

If different application methods or evaluations are made, please clearly specify differences in final report and explain how they enhanced results.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, pot/liner size, plant height & width, and plant growth stage at application and data collection dates. Because plants will be kept under fluorescent lights during part of the experiment, please measure light levels under these lights immediately after the simulated shipping period and include these readings in the final report.

Treatments:

Product	Priority Level	Rate	Special Instructions	Contact Information to obtain materials and any needed adjuvants
Fascination (BA, GA), Valent	A	21 ml/gal (100 ppm)	Single application when plants have at least one open flower or inflorescence	Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com
OR				Fine Americas, Kevin Forney, 661-588-7137, kevinf@fine-americas.com
Fresco (GA + BA), Fine	B	18 ml/gal (100 ppm)	Single application when plants have at least one open flower or inflorescence	Fine Americas, Kevin Forney, 661-588-7137, kevinf@fine-americas.com
OR				Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com
MaxCel (BA), Valent	B	1 g/liter (100 ppm)	Single application when plants have at least one open flower or inflorescence	Valent, Joe Chamberlin, 770-985-0303, jcham@valent.com
OR		OR		Fine Americas, Kevin Forney, 661-588-7137, kevinf@fine-americas.com
NovaGib (GA 4&7), Fine		38 ml/gal (100 ppm)		
Standards for ethylene sensitive plants (Select one)				
MCP	Standard	1 ppm	Applied as gas overnight at room temperature	
Silver thiosulfate	Standard			

	d			
Untreated		--	--	

Reports:

Reports must include:

Results summary (no more than one page)

Summary table with appropriate statistical analyses

Experimental design and materials and methods

Appendices: raw data and recordkeeping information as listed above

If pictures were taken, please include them.

A report submitted electronically is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-4880, E-mail: evvea@comcast.net.

Draft Date: 6/7/2006

Revised By: CLP

Impact of various PGRs on shelf life of herbaceous ornamentals grown in pots.

Ornamental Protocol Number: 07-015

Objective: Determine whether certain PGR materials increase the shelf-life of certain flowering, potted ornamentals

Experimental Design:

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: Minimum of 8 replications of 4 different varieties of crop species

Application Instructions: Time foliar spray applications to when each plant in the experiment has developed buds and at least open inflorescence, but do not wait until the majority of plants have more than three open inflorescences. Apply heavy foliar sprays (sprencches) using 2 – 3 quarts solution per 100 sq ft. *See Treatment List Table for additional details based on plant materials.* Maintain plants in greenhouse for 1 - 2 days. Then place them in boxes and keep in darkness for 48 hours to simulate shipping. For geraniums, please have the temperature be 20°C during this time. Then place plants into conditions simulating either a typical retail display facility (20°C 12 hours of fluorescent light, with watering as necessary) or a typical retail 'outdoor' display facility (25-30°C with some shading, natural light conditions). Evaluations will be made prior to simulated shipping, immediately after, and 7, 14, and 21 days after simulated shipping or until suitable relevant data cannot be collected, but no longer than 21 days.

Target Plant Species: Geranium, tulip, poinsettia, impatiens, two others tbd.

Use Site: Greenhouse/Field Container

Evaluations: Flower number, visual quality on a scale of 0 to 10 (with 0 being unsaleable and 10 being highly attractive), and phytotoxicity (with 0 being no phytotoxicity and 10 being plant death). Please include photos of examples of untreated plants and any treated plants exhibiting responses to treatments.

If different application methods or evaluations are made, please clearly specify differences in final report and explain how they enhanced results.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, pot/liner size, plant height & width, and plant growth stage at application and data collection dates. Because plants will be kept under fluorescent lights during part of the experiment, please measure light levels under these lights immediately after the simulated shipping period and include these readings in the final report.

Reports:

Reports must include:

Results summary (no more than one page)

Summary table with appropriate statistical analyses

Experimental design and materials and methods

Appendices: raw data and recordkeeping information as listed above

If pictures were taken, please include them.

A report submitted electronically is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-4880, E-mail: evvea@comcast.net.

Draft Date: 2/14/2011

Revised By: CLP

Impact of various PGRs on shelf life of herbaceous ornamentals grown in pots. **Final**

Ornamental Protocol Number: 08-013

Objective: Determine whether certain PGR materials increase the shelf-life of certain flowering, potted ornamental

Experimental Design: Phytotoxicity Screen

Replicates: For phytotoxicity screen, a minimum of 3 plants per rate per cultivar.

Treatments: ABA, BA, Exilis Plus, Maxcel, and Provide (or Novagib). See products list below for contact information.

Application Instructions: Apply heavy foliar sprays (srenches) using 2 – 3 quarts solution per 100 sq ft. Use 5, 10, 50, 100 ppm to screen for phytotoxicity with each product except ABA. For ABA spray and srench application use 250, 500, 1,000 ppm S-ABA + Capsil adjuvant at 0.05% and a spray volume of 2-3 quarts per 100 square feet. For drenching and flood application use 125, 250, 500 ppm applied as an overhead drench or flood bench/floor treatment at a volume that is 5-10% of the pot volume. The primary label suggestions for ABA are expected to be 250 ppm for drenching and 500 ppm for spraying.

Target Plant Species: Geranium and NG impatiens.

Use Site: Greenhouse/Field Container

Evaluations: Phytotoxicity (with 0 being no phytotoxicity and 10 being plant death). Please include photos of examples of untreated plants and any treated plants exhibiting responses to treatments.

If different application methods or evaluations are made, please clearly specify differences in final report and explain how they enhanced results.

Experimental Design: Herbaceous Storage

Plot Size: Must be adequate to reflect actual use conditions.

Replicates: For storage test, a minimum of 6 plants per rate per cultivar.

Application Instructions: Time foliar spray applications to when each plant in the experiment has developed buds and at least open inflorescence, but do not wait until the majority of plants have more than three open inflorescences. Apply heavy foliar sprays (srenches) using 2 – 3 quarts solution per 100 sq ft. Maintain plants in greenhouse for 1 - 2 days. Split plants into two sets. The first will be shipped to a cooperating researcher. The other set will be placed under simulated shipping and retail storage conditions: place plant in boxes and keep in darkness for 48 hours to simulate shipping (for geraniums, please have the temperature be 20°C during this time); then place plants into conditions with 20°C 12 hours of fluorescent light watering as necessary. Evaluations will be made prior to simulated shipping, immediately after, and 7, 14, and 21 days after simulated shipping or until suitable relevant data cannot be collected, but no longer than 21 days. For the ABA treatment and the untreated, a second set of plants will undergo the same conditions as above, but will not be watered after a single irrigation upon opening the boxes after shipping. This set of plants will also be evaluated for wilting.

Treatments List:

Active Ingredient	Shipping & Storage	Wilt Assessment
BA	Actual Shipping	No
	Simulated Shipping	No
BA + GA	Actual Shipping	No
	Simulated Shipping	No
GA	Actual Shipping	No
	Simulated Shipping	No
TDZ	Actual Shipping	No
	Simulated Shipping	No
ABA	Actual Shipping	No
	Simulated Shipping	No
	Actual Shipping	YES
	Simulated Shipping	YES

Untreated	Actual Shipping	No
	Simulated Shipping	No
	Actual Shipping	YES
	Simulated Shipping	YES

Target Plant Species: Geranium, NG impatiens.

Use Site: Greenhouse/Field Container

Evaluations: Flower number, visual quality on a scale of 0 to 10 (with 0 being unsaleable and 10 being highly attractive), and phytotoxicity (with 0 being no phytotoxicity and 10 being plant death). Please include photos of examples of untreated plants and any treated plants exhibiting responses to treatments.

If different application methods or evaluations are made, please clearly specify differences in final report and explain how they enhanced results.

Recordkeeping: Keep detailed records of weather conditions including temperature and precipitation, soil-type or soil-less media, application equipment, application volume per acre, irrigation, pot/liner size, plant height & width, and plant growth stage at application and data collection dates. Because plants will be kept under fluorescent lights during part of the experiment, please measure light levels under these lights immediately after the simulated shipping period and include these readings in the final report.

Reports:

Reports submitted on the standard IR-4 Ornamental Horticulture Research Report Form are preferred. However, reports in other formats are acceptable as long as those reports are amended with detailed experimental design and materials and methods, along with raw data, recordkeeping information, and any pictures.

A report submitted electronically is preferred but not required. If the report is provided electronically, the basic report can be sent in MS Word or WordPerfect, the recordkeeping information as pdf or other electronic documents, and the raw data in MS Excel or other suitable program such as ARM.

Please direct questions to: Cristi Palmer, IR-4 HQ, Rutgers University, 681 US Hwy 1 S, North Brunswick, NJ 08902-3390, Phone 732-932-9575 x629, palmer@aesop.rutgers.edu OR Ely Vea, 308 Aston Forest Lane, Crownsville, MD 21032, Phone & FAX#: 410-923-4880, E-mail: evvea@comcast.net.

Draft Date: 7/25/08

Revised By: CLP

Appendix 2: Contributing Researchers

Dr. Nora Catlin	Cornell University Cooperative Extension of Suffolk County Extension Education Center 423 Griffing Av., Ste 100 Riverhead, NY 11901-3071
Dr. Yan Chen	LSU Ag Center Hammond Research Station 21549 Old Covington Hwy. Hammond, LA 70403
Dr. Bill Miller	Dept. of Horticulture Cornell University Ithaca, NY 14853
Dr. Brent Pemberton	Texas A & M University Agricultural Research and Education Center P. O. Box E Overton, TX 75684
Dr. Mike Reid	Dept. of Plant Sciences University of California, Davis One Shields Avenue Davis, CA 95616
Dr. Erik Runkle	Michigan State University Department of Horticulture A288 Plant & Soil Science Bldg. East Lansing, MI 48824

Appendix 3: Submitted Data

Researcher reports included in the printed copy of this report are those received by 1/31/2011. Reports on following pages are in alphanumeric order of author and PR number. Electronic reports can be found at <http://ir4.rutgers.edu/Ornamental/Ornamentals.cfm>.

Appendix 4: Citations for Non-IR-4 Data

Miller, William B. and Kim, H. [GA₄₊₇ plus BA enhances postproduction quality in pot tulips.](#)
Postharvest Biology and Technology, Volume 51, Issue 2, February 2009, Pages 272-277