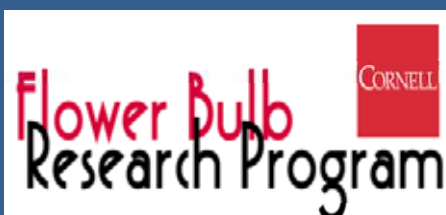


RESEARCH NEWSLETTER



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Evaluations of paclobutrazol (Bonzi) and flurprimidol (Topflor) media drenches and tuber dips on Dutch grown calla lilies (Zantedeschia)


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As a part of the Flower Bulb Research Program at Cornell University, we conducted a calla lily study in summer 2008 (see Research Newsletter, Dec. 2008) evaluating plant growth regulator (PGR) drench effects of calla lily growth and development. A follow-up study was conducted in summer 2009 to further evaluate PGR drenches and dips and their effects on calla growth and development during greenhouse production.

Zantedeschia, or calla lily, is a popular cut-flower in the floriculture industry. Zantedeschia is also increasing in popularity as a flowering pot crop as breeding efforts have produced plants more suitable for pot production. There are opportunities to evaluate growth and development of these newer cultivars as production of both cut and pot calla increases.

Aesthetic appeal is important for marketing floriculture crops and is often achieved through controlling plant growth and development. Several factors including plant species (and cultivar), temperature, light quality and intensity and water availability affect plant growth and development and it can be difficult to control all parameters, especially for growers who do not produce only one or two types of crops. Often plant growth regulators (PGRs) are applied during greenhouse production to control growth and development and achieve a quality marketable product.



Several plant hormones affect plant growth and development. One example is gibberellin. This plant hormone is involved in shoot elongation and stimulating flower development. Rarely are greenhouse producers interested in increasing plant height, and if increased height is desired, it is much easier to achieve using some cultural production factor previously listed. Thus, to reduce plant height, anti-gibberellins typically used to reduce shoot elongation at a specific stage of growth. Two common commercially applied anti-gibberellins are paclobutrazol (Bonzi or Piccolo) and flurprimidol (Topflor). Depending on the crop, each PGR has an optimum application method (spray, soil drench, bulb soak), application rate, and timing. For callas, media drenches and application at an early growth stage are keys to effective height control. The goal of this study was to evaluate effectiveness of paclobutrazol and flurprimidol drenches and tuber dips on height control of 8 calla lily cultivars.

Materials and Methods

Tubers of eight calla cultivar tubers were supplied by the Research Committee and received by air-freight on 22 June 2009. Tubers were stored at 15-17°C until planting. Tubers had a minimum grade of 18 cm.

Media Drenches. Tubers were planted one per 15 cm pot with the eyes 2.5 cm deep in Sunshine LC8 potting media. Nine PGR drench treatments were applied to each of the 6 replications of each treatment per cultivar. Treatments included drenches of reverse osmosis water (RO, control) and 1.5, 3.0, 4.5, and 6.0 mg active ingredient per pot of paclobutrazol (Bonzi) or flurprimidol

(Topflor). Drenches of 120 ml per pot were applied when shoot growth reached 2.5 to 7.5 cm. There were 8 pots per treatment.


Tuber Dips. Tubers of 6 cultivars (Odessa, Captain Cupido, Captain Murano, Rose Queen, Captain Sonora, Serrada) were soaked individually for 60 minutes in plastic cups before planting. Seven treatments included RO water (control), paclobutrazol (Bonzi) at 100 and 200 mg/L, ancymidol (Sumagic) at 10 and 25 mg/L, and flurprimidol (Topflor) at 50 and 100 mg/L. After treatment, one tuber was planted per 15 cm pot with the eyes 2.5 cm deep in Sunshine LC8 potting media. There were 8 pots per treatment.

Plants for both media drenches and tuber dips were grown in a glasshouses at constant 21°C under natural daylengths at 42°N latitude and fertilized with 150 mg/L N of 15N-2P-10.8K. Data collected included date of first flower color, height of first flower, and height of leaves at first flower. There were 8 pots per treatment.

Results

Media Drenches

PGR media drenches showed significant effects with the cultivars tested in this study as compared to the research conducted in summer 2008 (Table 1; Figs. 1-8). Generally, there was little difference between Bonzi and Topflor and their ultimate ability to reduce leaf and flower height. As would be expected, cultivar differences were observed as to their overall response to PGR drench applications. For most cultivars, as PGR concentration increased, leaf and flower heights decreased, e.g. cultivars Captain Murano, Mercedes, and Captain



Reno. However, there was not always a significant difference (statistically) between increasing PGR concentrations in Bonzi treatments. Increasing PGR drench rate had little effect on days to flower (Table 2). The time to flower increased slightly with increasing PGR concentration, but not significantly to cause concern in order for a producer to meet a specific market date. Compared to 2008 experiments, most plants flowered about a week earlier, reflecting the warmer growing season (in 2008, tubers were planted in early April, versus late June for the current experiments). In many cases, the PGR treatments reduced the number of flowers, although as can be seen from the pictures, the effect was often not noticeable, and there did not seem to be a dose response. Cultivars also varied in the number of “colored leaves”, which we believe are transitional leaves that did not fully develop into flowers. While some cultivars have more than others, the number was not related to any treatment.

Preplant Tuber Soaks

Pre-plant tuber soaks were moderately successful in controlling growth and development of callas (Table 3). For most cultivars, soaks of Bonzi and Topflor were more effective in controlling leaf and flower height than Sumagic soaks. For each PGR, the higher concentration treatment was generally more effective (decreasing height of leaves and flowers), as would be expected. However, there were examples of too much regulation that resulted in plant stature that was not very aesthetically appealing, as flowers were primarily in or below the foliage, e.g. cultivars Rose Queen, Captain Cupido and Captain Murano (Figs. 9 and 10).). As in the drench study, the PGR treat-

ments tended to reduce the number of flowers, although as can be seen from the pictures, the effects were often not noticeable, and there did not seem to be a dose response. Cultivars also varied in the number of “colored leaves”, which we believe are transitional leaves that did not fully develop into flowers. While some cultivars have more than others, the number was not related to any treatment.

Erwinia

A major pathogen concern during greenhouse production of callas is soft rot or *Erwinia carotovora* subsp. *Carotovora*. Tuber pretreatment, along with careful observation (rouging and chemical applications if applicable) during crop production can reduce the amount of infection. Cultivar differences also play an important role in soft rot susceptibility, as was observed in this study (Tables 1 and 2). However, the susceptibility of a specific cultivar to *Erwinia* can be variable and cannot be determined from a single experiment. All components of the disease triangle (host, environment, and pathogen) are necessary in order for a positive infection. Other influences on these components may include shipping and handling practices, culturing conditions, infected tubers in bulb crates etc. were not controlled for in this study. It should also be noted that this was a summer experiment, a time when callas are most susceptible to *Erwinia*.

Conclusions

The first PGR study we conducted in 2008 unexpectedly showed little response to the PGR concentrations used. We hypothesized that the large tuber size in 2008 played a role in the lack

of response, directly related to an insufficient PGR concentration. With the current study, the tubers supplied were more in line with sizes a typical commercial grower would force.

Few differences were observed between Topflor and Bonzi in their ability to reduce both leaf and flower heights in media drenches. Thus, the choice of which PGR could be based on price and/or which material might already be a part of a grower's greenhouse production practices. At current prices, Bonzi and Topflor costs are approximately 4 and 3 cents (US) per milligram, respectively (but this depends on the quantity purchased). In terms of specific concentrations to be applied, the highest rate of 6.0 mg a.i. (Bonzi or Topflor) most often reduced flower and leaf height by ~30% or more and the resulting plant stature appeared to be too short, at least for 15 cm pots. Moreover, most of the cultivars tested in this study were bred with the intention to be forced as potted plants, thus genetically inclined to be shorter. Lower concentrations of 1.5 to 3.0 mg a.i. (Bonzi or Topflor) would be acceptable rates for drenching. As is suggested with all PGR applications, it is advised that a grower test a small sample of a crop and maintain accurate records under their greenhouse conditions before applying to a large crop of calla lilies.

Several studies have shown the effectiveness of pre-plant PGR bulb soaks, including this study. Our results show that the effectiveness of various PGRs is variable, and having a choice, Bonzi or Topflor are more effective than Sumagic. Results will vary with greenhouse culture conditions and the grower may have to adjust the application rates accordingly to attain similar results. More-

over, careful attention must be paid to the concentrations applied so as not to produce potted callas that would be marginally marketable.

Regarding calla tuber soaks, it would be typical to soak several (hundred) bulbs simultaneously. In this study, we soaked each tuber individually to reduce the spread of Erwinia, but still observed several cases of Erwinia. For example, all six control replicates for Rose Queen became infected. From a disease standpoint, using PGR soaks as a commercial height control strategy is not advised, but experiments were done to illustrate potential results! Media PGR drenches are an economically viable and much safer way of controlling calla lily plant growth and development.

Table 1. Dutch grown calla lily cultivars used for 2009 PGR studies.

Cultivar	Color	Tuber size (cm)	Media drench	Tuber Soak
Captain Cupido	White	18-20	X	X
Captain Murano	Rose-red	18-20	X	X
Captain Reno	Purple	18-20	X	
Captain Sonora	Yellow	20+	X	X
Odessa	Black-red	18-20	X	X
Mercedes	Peach	20+	X	
Rose Queen	Rose-pink	18-20	X	X
Serrada	Yellow	18-20	X	X

Table 2. Bonzi and Topflor media drench effects on growth and development of eight Dutch calla lily cultivars. Flower and leaf heights measurements were taken at first flower for each replication. For flower stem length, leaf length and number of flowers, the percentage change relative to the control is also given.

Cultivar	PGR treatment (mg/pot a.i.)	Flower height (cm)	Flower height reduction compared to controle (%)	Leaf height (cm)	Leaf height reduction compared to controle (%)	Days to flower	Erwinia infection (%)	Flowers (#)	Flower reduction or increase compared to controle (%)	Number of colored leaves
Captain Cupido	Control	30	-	36	-	39	---	18	---	2
	1.5 Bonzi	23	23	31	14	41	---	14	-22	3
	3.0 Bonzi	23	23	29	19	42	---	15	-17	4
	4.5 Bonzi	24	20	30	17	40	---	14	-22	2
	6.0 Bonzi	22	27	28	22	44	---	14	-22	4
	1.5 Topflor	25	17	31	14	42	---	16	-11	2
	3.0 Topflor	23	23	29	19	40	---	17	-6	3
	4.5 Topflor	23	23	27	25	41	---	15	-17	2
	6.0 Topflor	20	33	27	25	35	---	17	-6	3
Captain Murano	Control	35	-	37	-	38	17	10	---	1
	1.5 Bonzi	28	20	35	5	34	17	10	0	1
	3.0 Bonzi	28	20	31	16	38	17	6	-40	1
	4.5 Bonzi	26	28	32	14	40	17	7	-30	0
	6.0 Bonzi	24	31	31	16	40	---	8	-20	1
	1.5 Topflor	31	11	35	5	36	---	9	-10	1
	3.0 Topflor	29	17	34	8	39	17	10	0	0
	4.5 Topflor	24	31	32	14	36	50	7	-30	2
	6.0 Topflor	20	43	28	24	37	17	6	-40	0
Captain Reno	Control	38	-	45	-	41	17	16	---	1
	1.5 Bonzi	32	16	42	7	43	---	12	-25	1
	3.0 Bonzi	31	18	42	7	43	---	13	-19	1
	4.5 Bonzi	28	26	37	18	46	---	10	-38	1
	6.0 Bonzi	27	29	40	11	48	---	11	-31	2
	1.5 Topflor	33	13	41	7	45	---	13	-19	1
	3.0 Topflor	28	26	35	7	46	---	10	-38	2
	4.5 Topflor	27	29	38	18	47	---	8	-50	1
	6.0 Topflor	23	39	34	11	46	---	11	-31	1
Captain Sonora	Control	36	-	44	-	37	---	14	---	1
	1.5 Bonzi	38	5	38	14	38	---	9	-36	1
	3.0 Bonzi	30	17	34	23	36	---	11	-21	1
	4.5 Bonzi	29	19	33	25	39	---	9	-36	1
	6.0 Bonzi	29	19	34	23	38	---	11	-21	1
	1.5 Topflor	35	3	37	16	37	---	12	-14	1
	3.0 Topflor	30	17	35	20	37	---	11	-21	1
	4.5 Topflor	31	14	33	25	38	---	13	-7	1
	6.0 Topflor	27	25	32	27	40	---	10	-29	0
Mercedes	Control	35	-	41	-	38	---	14	---	3
	1.5 Bonzi	26	26	34	17	41	---	14	0	2
	3.0 Bonzi	26	26	33	20	40	---	12	-14	3
	4.5 Bonzi	20	43	32	22	36	---	14	0	2
	6.0 Bonzi	23	34	32	22	39	---	13	-7	3
	1.5 Topflor	27	23	33	20	37	---	13	-7	4
	3.0 Topflor	26	26	34	17	39	---	12	-14	3
	4.5 Topflor	20	43	30	27	41	---	12	-14	3
	6.0 Topflor	21	40	26	37	41	---	13	-7	3
Odessa	Control	38	-	40	-	57	17	10	---	2
	1.5 Bonzi	34	11	35	13	55	17	10	0	1
	3.0 Bonzi	32	16	31	23	58	17	9	-10	2
	4.5 Bonzi	24	37	26	35	60	---	5	-50	1
	6.0 Bonzi	21	45	21	48	63	17	5	-50	1
	1.5 Topflor	31	18	32	20	51	17	13	30	1
	3.0 Topflor	27	29	28	30	53	17	10	0	1
	4.5 Topflor	25	34	27	33	52	17	11	10	2
	6.0 Topflor	23	39	24	40	56	---	9	-10	2
Rose Queen	Control	30	-	37	-	36	---	11	---	3
	1.5 Bonzi	23	23	32	14	37	---	11	0	2
	3.0 Bonzi	23	23	29	22	37	---	11	0	3
	4.5 Bonzi	24	20	30	19	33	---	12	10	3
	6.0 Bonzi	22	27	28	24	43	---	8	-27	2
	1.5 Topflor	21	30	29	22	37	---	9	-18	2
	3.0 Topflor	25	17	32	14	44	17	10	-9	2
	4.5 Topflor	21	30	28	24	42	---	8	-27	3
	6.0 Topflor	22	27	27	27	39	---	10	-9	3
Serrada	Control	39	-	42	-	35	---	6	---	0
	1.5 Bonzi	33	15	35	17	33	---	7	17	0
	3.0 Bonzi	28	28	30	29	31	---	5	-17	0
	4.5 Bonzi	31	21	32	24	37	---	6	0	0
	6.0 Bonzi	33	15	30	29	36	33	7	17	0
	1.5 Topflor	36	8	35	17	39	17	6	0	0
	3.0 Topflor	34	13	33	21	35	33	7	17	0
	4.5 Topflor	33	15	30	29	33	17	6	0	0
	6.0 Topflor	30	23	29	31	34	17	7	17	1

Table 3. Effects of 60 minute preplant tuber soaks in Sumagic, Topflor or Bonzi on growth and development of six Dutch calla lily cultivars. Flower and leaf heights measurements were taken at first flower for each replication. For flower stem length, leaf length and number of flowerts, the percentage change relative to the control is also given.

Cultivar	PGR treatment	Flower height (cm)	Flower height reduction to compared to control (%)	height (cm)	Leaf height reduction to compared to control (%)	Days to flower	Erwinia infection (%)	Flowers (#)	Flower reduction or increase compared to controle (%)	Number of colored leaves
Captain Cupido	Control	26	—	38	—	37	0	15	—	2
	10 ppm Sumagic	23	-12	31	-18	39	0	12	-20	2
	25 ppm Sumagic	22	-15	28	-26	39	0	16	7	3
	50 ppm Topflor	22	-15	30	-21	41	17	16	7	3
	100 ppm Topflor	17	-35	25	-34	36	0	19	27	3
	100 ppm Bonzi	21	-19	27	-29	41	0	18	20	3
	200 ppm Bonzi	21	-19	26	-32	44	0	13	-13	3
Captain Murano	Control	24	—	34	—	30	17	10	—	1
	10 ppm Sumagic	25	4	33	-3	33	0	8	-20	1
	25 ppm Sumagic	25	4	31	-6	35	0	8	-20	1
	50 ppm Topflor	26	8	33	-3	34	17	9	-10	1
	100 ppm Topflor	20	-17	25	-26	35	33	9	-10	1
	100 ppm Bonzi	23	-4	29	-15	41	0	7	-30	1
	200 ppm Bonzi	19	-21	24	-29	37	17	6	-40	0
Captain Sonora	Control	33	—	39	—	34	0	13	—	1
	10 ppm Sumagic	26	-21	32	-18	39	0	8	-38	1
	25 ppm Sumagic	32	-3	35	-10	36	0	11	-15	0
	50 ppm Topflor	33	0	35	-10	40	0	10	-23	1
	100 ppm Topflor	22	-33	29	-26	34	0	12	-8	1
	100 ppm Bonzi	29	-12	33	-15	38	0	9	-31	1
	200 ppm Bonzi	24	-27	31	-21	37	0	9	-31	0
Odessa	Control	36	—	44	—	49	17	10	—	1
	10 ppm Sumagic	35	-3	34	-23	48	0	10	0	2
	25 ppm Sumagic	34	-6	35	-20	48	0	8	-20	1
	50 ppm Topflor	32	-11	34	-23	54	0	9	-10	1
	100 ppm Topflor	29	-19	27	-39	50	0	10	0	2
	100 ppm Bonzi	28	-22	28	-36	50	0	8	-20	1
	200 ppm Bonzi	28	-22	25	-43	54	0	7	-30	1
Rose Queen	Control*	30	—	37	—	36	100	11	—	3
	10 ppm Sumagic	34	13	31	-16	42	0	10	-9	3
	25 ppm Sumagic	32	7	32	-14	36	0	11	0	3
	50 ppm Topflor	20	-33	30	-19	43	67	9	-18	2
	100 ppm Topflor	22	-27	26	-30	40	0	13	18	4
	100 ppm Bonzi	19	-37	28	-24	43	0	9	-18	3
	200 ppm Bonzi	19	-37	23	-38	40	0	10	-9	3
Serrada	Control	34	—	40	—	35	17	6	—	0
	10 ppm Sumagic	33	-3	35	-13	31	17	8	33	0
	25 ppm Sumagic	40	18	37	-8	36	17	6	0	0
	50 ppm Topflor	33	-3	32	-20	36	33	6	0	1
	100 ppm Topflor	30	-12	31	-23	34	0	7	16	1
	100 ppm Bonzi	29	-15	29	-28	30	0	6	0	0
	200 ppm Bonzi	33	-3	29	-28	37	0	6	0	0

*Due to 100% mortality rate due to Erwinia, data shown is for Rose Queen control treatments of the PGR drench study.

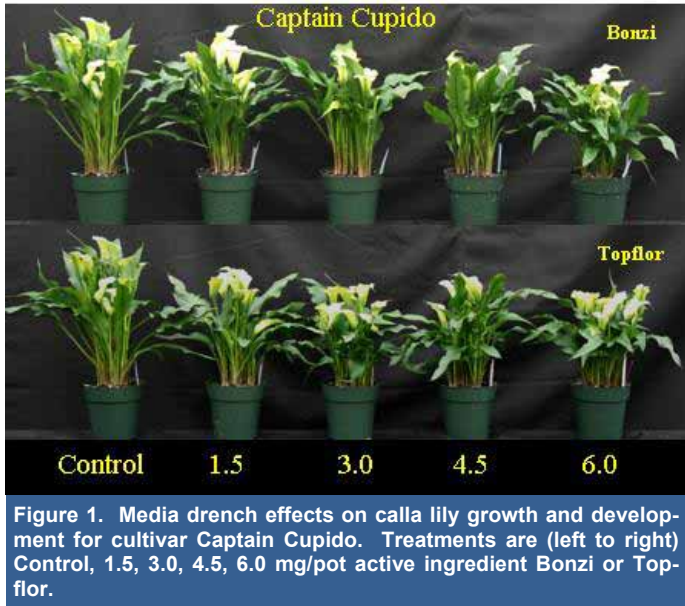
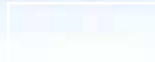


Figure 1. Media drench effects on calla lily growth and development for cultivar Captain Cupido. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.

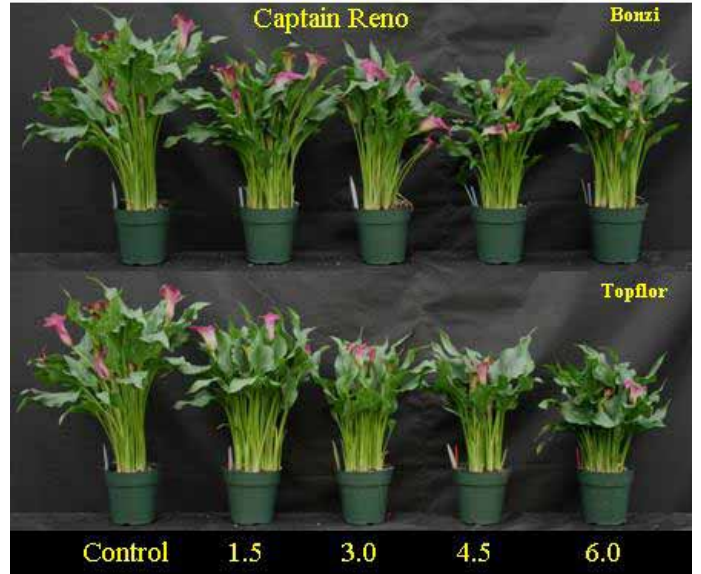


Figure 3. Media drench effects on calla lily growth and development for cultivar Captain Reno. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.



Figure 2. Media drench effects on calla lily growth and development for cultivar Captain Murano. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.



Figure 4. Media drench effects on calla lily growth and development for cultivar Captain Sonora. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.

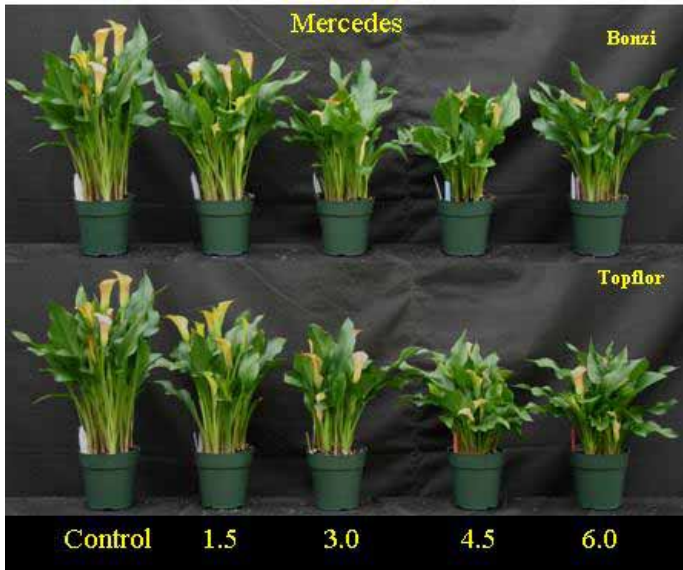


Figure 5. Media drench effects on calla lily growth and development for cultivar Mercedes. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.

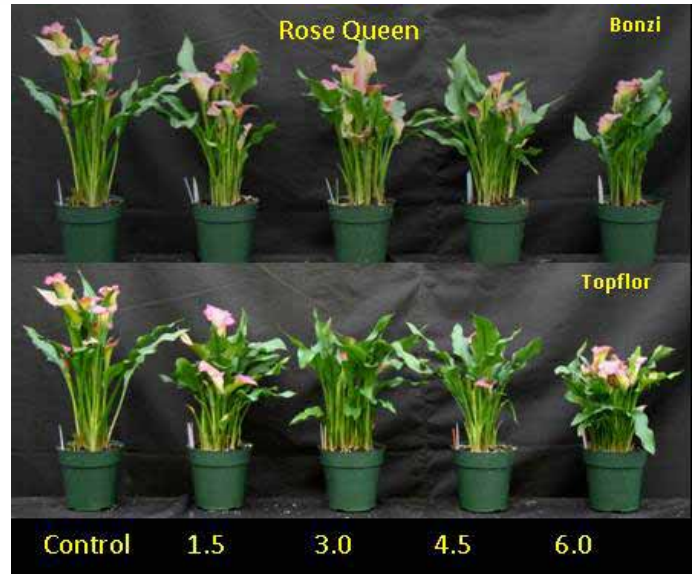


Figure 7. Media drench effects on calla lily growth and development for cultivar Rose Queen. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.

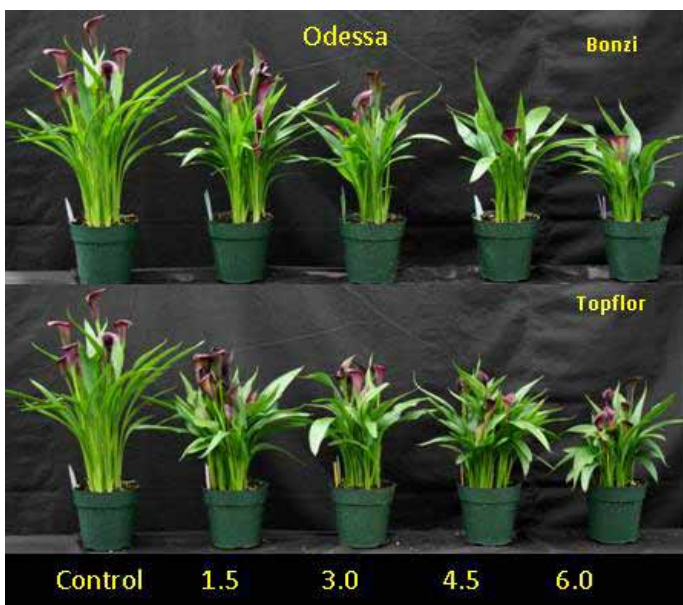


Figure 6. Media drench effects on calla lily growth and development for cultivar Odessa. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.



Figure 8. Media drench effects on calla lily growth and development for cultivar Serrada. Treatments are (left to right) Control, 1.5, 3.0, 4.5, 6.0 mg/pot active ingredient Bonzi or Topflor.

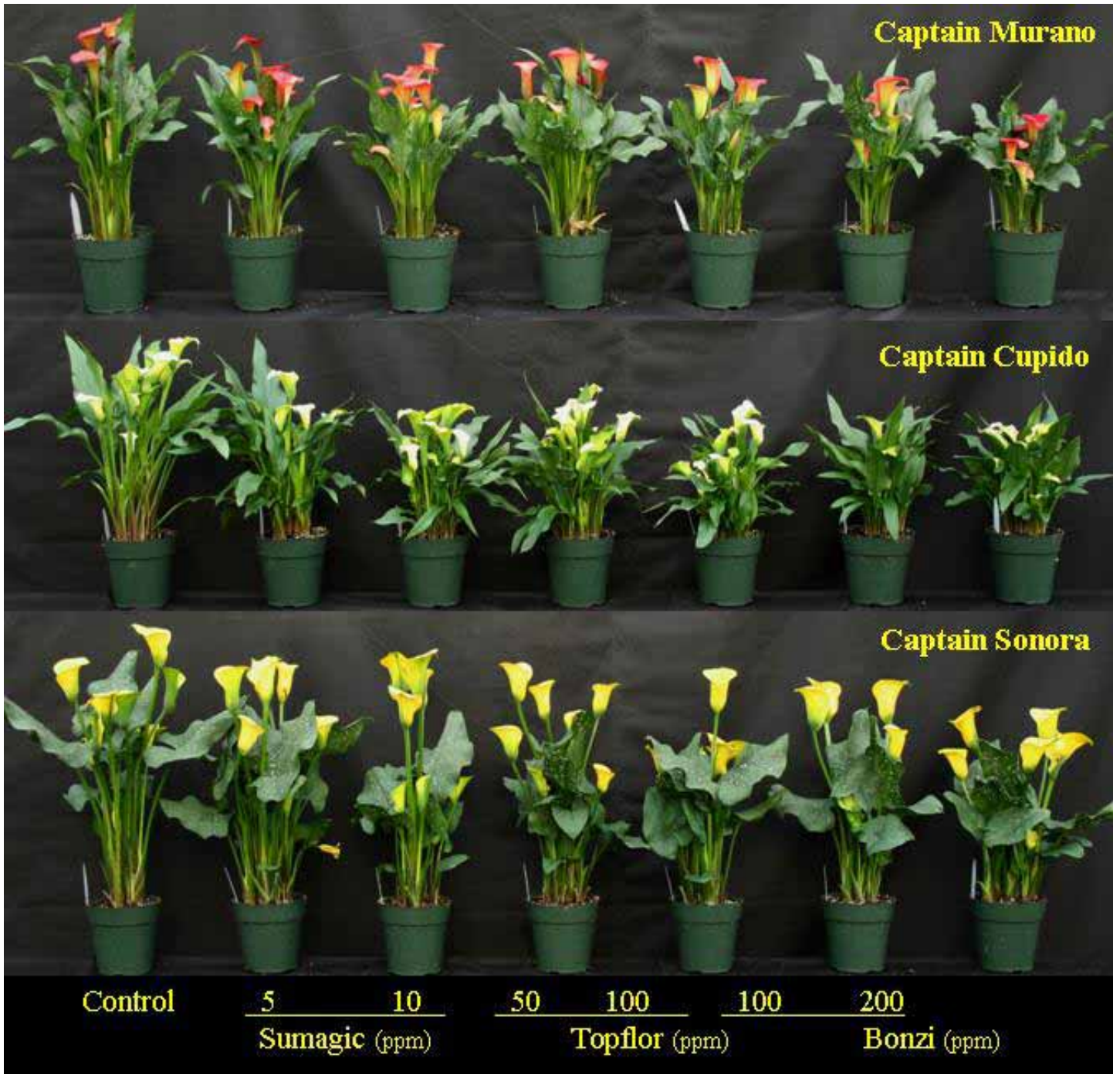


Figure 9. Effects of 60 minute preplant tuber soaks on calla lily growth and development of cultivars Captain Murano, Captain Cupido, and Captain Sonora. Treatments are (left to right) Control, 5 and 10 ppm Sumagic, 50 and 100 ppm Topflor, and 100 and 200 ppm Bonzi.

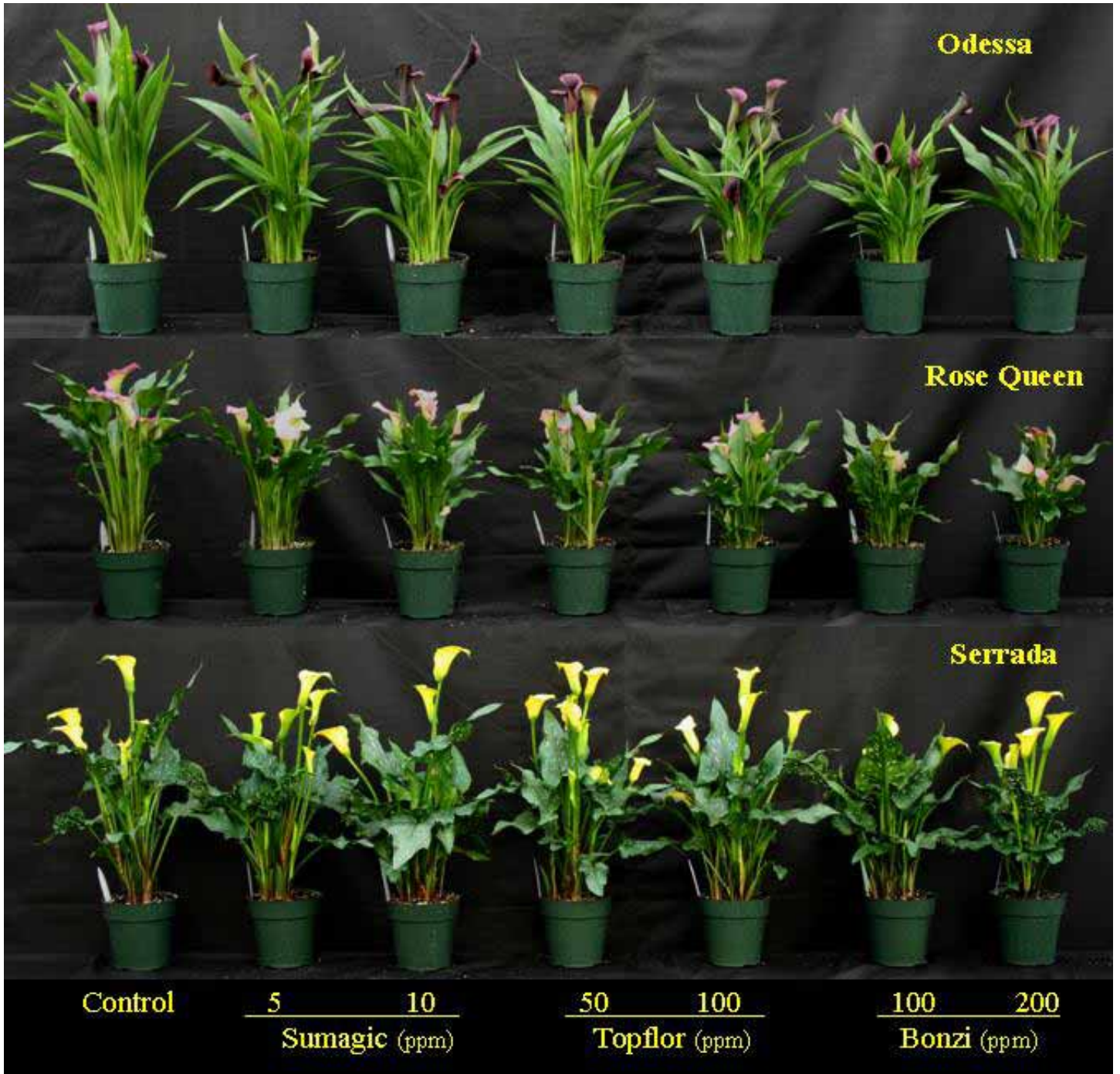


Figure 10. Effects of 60 minute preplant tuber soaks on calla lily growth and development of cultivars Odessa, Rose Queen, and Serrada. Treatments are (left to right) Control, 5 and 10 ppm Sumagic, 50 and 100 ppm Topflor, and 100 and 200 ppm Bonzi.