Growth Regulator Effects in Seed Propagated *Begonia* x *Tuberhybrida*

Meriam G. Karlsson
Associate Professor of Horticulture
Agricultural and Forestry Experiment Station
University of Alaska Fairbanks

Jeffrey W. Werner
Student Assistant
Agricultural and Forestry Experiment Station
University of Alaska Fairbanks

Jan T. Hanscom
Research Associate
Agricultural and Forestry Experiment Station
University of Alaska Fairbanks

University of Alaska Fairbanks

Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management

Circular 90 July 1992

Abstract

The growth regulators chlormequat (Cycocel), paclobutrazol (Bonzi), daminozide (B-Nine) and Bayleton 25WP (triadimefon) were studied for their ability to control plant height in seed propagated tuberous begonia ('Nonstop' begonias). Bayleton is a fungicide used for powdery mildew control that also has growth regulator effects. Two ml growth regulator solution was evenly sprayed on each plant two weeks after transplanting. Cycocel (500 parts per million [ppm], 1 mg active ingredient [a.i.] per plant) resulted in 23% shorter plants than the control plants 15 weeks after transplant. Bonzi (5 ppm, 0.01 mg a.i. per plant) treated begonias were 65% and Bayleton (150 mg • liter $^{-1}$, 0.3 mg per plant) treated plants 43% shorter than the control plants. The number of flowers and shoots was severely reduced on plants treated with Bonzi or Bayleton. B-Nine was ineffective at the rate of 3000 ppm (6 mg a.i. per plant) for controlling plant height of seed propagated tuberous begonia.

Introduction

The seed propagated 'Nonstop' type cultivars of *Begonia* x *tuberhybrida* (tuberous begonia) were introduced in the 1970s and the production of *B.* x *tuberhybrida* increased rapidly. Nonstop type begonias as well as many other bedding plants are often treated with growth regulators to maintain a compact growth habit during early development. Shorter plants are easier to handle during marketing and planting. Many recommendations for growth regulator applications to seed propagated tuberous begonia have been based on results with *Begonia* x *hiemalis* (hiemalis begonia, elatior begonia, Rieger begonia) or the tuberous propagated *B.* x *tuberhybrida*.

Several commercially available growth regulators have the potential to control height in *B.* x *tuberhybrida*. The most commonly used growth regulator to begonias is chlormequat (Cycocel) applied as a spray at 500–1,000 parts per million (ppm) of active ingredient (a.i.), (Christensson, 1986). Cycocel may cause leaf yellowing at effective application rates for stem elongation control although plants usually recover from these injuries by marketing time (Kaczperski et al., 1989). Recommended time for Cycocel application is 14 days after pinch or 30 days after transplant (Evers, 1987; Kaczperski et al., 1989). Paclobutrazol (Bonzi) will control stem elongation of *B.* x *tuberhybrida* at a low application concentration. The most suitable rate of Bonzi spray application for hiemalis begonia is reported as 5 ppm (Hilding, 1990). Daminozide (B-Nine) has been reported ineffective for reducing height but may decrease the time required for development and flowering (Kaczperski et al., 1989). In addition to controlling powdery mildew in hiemalis and tuberous begonias, Bayleton 25WP or Strike 25DF (triadimefon) applications also result in shorter plants (Mikkelsen, 1989). Bayleton is labeled for use on begonias grown outdoors only. The recommended rate for powdery mildew control on begonias with Bayleton is 150 to 300 mg • liter $^{-1}$. The effect of Cycocel, Bonzi, B-Nine and Bayleton applications on growth and development of *B.* x *tuberhybrida* was determined in this study.

Materials and Methods

Seeds of *B.* x *tuberhybrida* 'Musical Orange' were germinated at 24° C and a photoperiod of 24 hours at a photosynthetic photon flux (PPF) of 100 µmol • m $^{-2}$ s $^{-1}$ (8.6 mol • m $^{-2}$ day $^{-1}$). The temperature was changed two weeks after seeding to 20 ± 2° C day and 18 ± 2° C night, and the day length to 16 hours at a PPF of 100 µmol • m $^{-2}$ s $^{-1}$ (5.8 mol • m $^{-2}$ day $^{-1}$). Seedlings were transplanted six weeks after seeding into 750-ml pots filled with a peat-lite medium (Fisons Sunshine Mix No. 4). Two weeks after transplant, 100 plants of uniform size (approximately 1.2 cm in height and with three expanded leaves) were selected and randomly assigned to the ten treatments. Plants were treated with a foliar application at rates of 500 or 1,000 ppm Cycocel, 5 or 10 ppm Bonzi, 2,000 or 3,000 ppm B-Nine, and 150 or 300 mg • liter $^{-1}$ Bayleton 25WP. The ten plants in each treatment were placed pot to pot and sprayed using a plastic spray head attached to a graduated syringe. The 20-ml spray volume was evenly distributed among the plants resulting in an application rate per plant of 1 or 2 mg a.i. Cycocel, 0.01 or 0.02 mg a.i. Bonzi, 4 or 6 mg a.i. B-Nine, and 0.3 or 0.6 mg Bayleton. Control plants were sprayed with the same volume of water as the plants treated with growth regulator. Plants were randomized and placed on the greenhouse bench using one outside guard row of plants. Plant height, plant part dry weights, and number of leaves, shoots and flowers were quantified 15 weeks after transplant (13 weeks after foliar growth regulator application). Results are given as averages of plants in a treatment ± SE (standard error).

Results and Discussion

Growth regulators had significant effects on all studied plant characteristics. Application rate and interactions had no significant effects on the plant characteristics documented. Increased application rates did not positively impact plant development when compared to the lower rates used in this study. With no statistical differences among application rates, data were pooled over rates for each growth regulator in the continued analyses.

Table 1. *Plant height, internode length, shoot and flower number 15 weeks after transplant (13 weeks after growth regulator application) of Begonia x tuberhybrida 'Musical Orange'.*[1]

Treatment	Plant Height (cm)	Internode Length (cm)	Leaves Main Shoot	Shoots per Plant	Flowers per Plant
Control	29 a	2.0 a	14 a	6 ab	50 a
Cycocel	22 b	1.4 b	13 a	7 a	36 b
Bonzi	10 d	0.8 c	10 b	4 c	17 c
B-Nine	27 ab	1.8 a	13 a	6 ab	46 ab
Bayleton	16 c	1.3 b	10 b	5 bc	20 c

[1] Mean separation in columns by least significant difference (lsd). Treatment means followed by the same letter in each column are not significantly different at P = 0.05.

Table 2. *Plant dry weight and dry weight partitioning into roots, stems, leaves and flowers 15 weeks after transplant (13 weeks after growth regulator application) of Begonia x tuberhybrida 'Musical Orange'.*[1]

Treatment	Total Plant Dry Weight (grams)	Partitioning of Dry Weight (%)			
		Roots	Stems	Leaves	Flowers
Control	8.2 a	12 a	27 a	46 b	15 b
Cycocel	8.2 a	16 a	19 c	51 c	14 ab
Bonzi	4.0 b	24 b	10 e	50 c	16 b
B-Nine	7.2 a	14 a	23 b	42 a	21 c
Bayleton	5.1 b	25 b	15 d	49 bc	11 a

[1] Mean separation in columns by least significant difference (lsd). Treatment means followed by the same letter in each column are not significantly different at P = 0.05.

Plant and Internode Lengths

'Musical Orange' begonia plants treated with Cycocel, Bonzi or Bayleton were shorter than the control plants (Table 1) 15 weeks after transplant (13 weeks after growth regulator application). B-Nine treated plants were not significantly shorter than the control plants (28.6 ± 0.3 cm). Bonzi treatments produced the shortest plants (10.1 ± 1.6 cm) followed by Bayleton treated plants (16.4 ± 2.3 cm) and plants treated with Cycocel (22.1 ± 1.3 cm).

Internode length followed the trends observed for total plant height (Table 1). The average internode length for the main shoot of the control plants was 2.0 ± 0.04 cm. Internode lengths were similar for Cycocel and Bayleton treated begonias with 1.4 ± 0.11 cm for Cycocel, and 1.3 ± 0.06 cm for Bayleton. Internode lengths were 1.8 ± 0.15 cm and 0.8 ± 0.09 cm for B-Nine and Bonzi treated plants. Although the Cycocel and Bayleton treated plants had similar internode lengths, the total plant height was shorter for plants in Bayleton treatments compared to Cycocel treatment. The number of leaves and internodes was not consistent for plants in all treatments (Table 1). Control plants had 14 ± 0.2 leaves on the main shoot at the time of data collection 15 weeks after transplanting. Plants treated with Bayleton or Bonzi had 10 leaves on the main stem and the Cycocel and B-Nine treated plants had 13 leaves.

Shoot and Flower Number

The average number of shoots per plant varied from 4 to 7 (Table 1). The greatest number of shoots per plant (7 ± 0.4) was observed with Cycocel although not significantly different from plants treated with B-Nine (6 ± 0.5) or the control plants (6 ± 0.3). The fewest shoots were observed with Bonzi (4 ± 0.5). Few shoots per

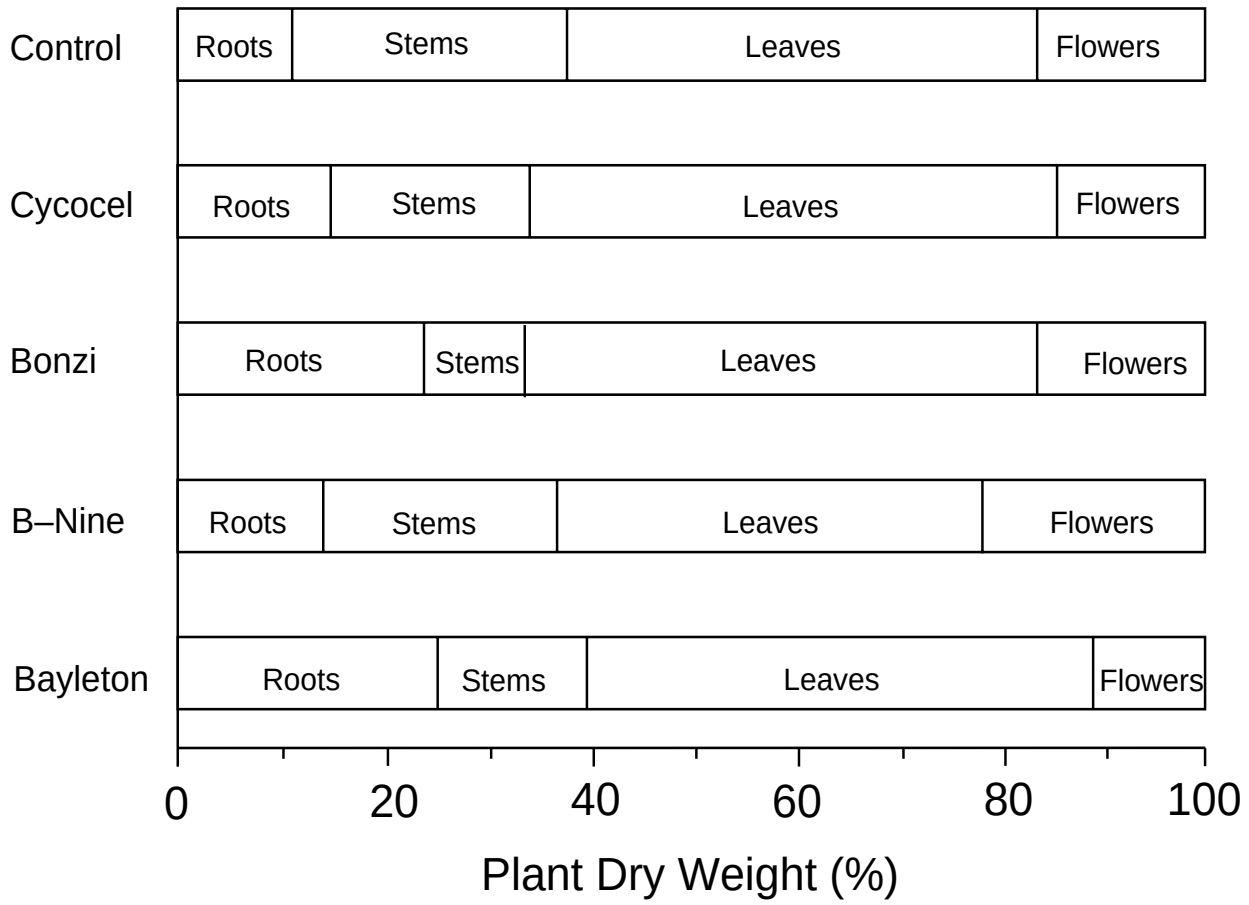

Figure 1. *Percentage dry weight in roots, stems, leaves and flowers 15 weeks after transplant (13 weeks after growth regulator application) of Begonia x tuberhybrida 'Musical Orange'.*

plant would be expected to decrease the potential for flower formation. Plants treated with Bonzi or Bayleton had significantly fewer shoots per plant and significantly fewer buds and open flowers per plant after 15 weeks of growth following transplant than other treatments (Table 1). Untreated begonia plants and plants treated with B-Nine had about 50 buds and open flowers per plant.

Dry Weight Accumulation and Partitioning

The largest total plant dry weight at 8.2 g was recorded for plants treated with Cycocel and for control plants (Table 2). B-Nine treated plants had 7.2 ± 0.1 g, Bonzi treated plants (4.0 ± 0.49 g) and Bayleton treated plants had 5.1 ± 0.25 grams of total plant dry weight.

Percentage dry weight allocated to stem tissue was significantly less for plants in all treatments compared to the control (Table 2, Figure 1). Plants treated with Bonzi (10% stem dry weight) and Bayleton (15% stem dry weight) had a smaller proportion stem dry weight than the 27% partitioned to stems in the control plants. In addition to having a low proportion stem dry weight, Bonzi and Bayleton treated plants had a significantly larger proportion root dry weight (24% and 25% respectively) than plants in other treatments (16% for Cycocel treated plants and 14% for B-Nine treated plants) and the control (12%). The proportion leaf dry weight varied from 42% to 51% among plants in the different treatments. Plants treated with Cycocel and Bonzi had similar proportion flower dry weight as the control plants (16%). Plants treated with B-Nine had a significantly larger proportion flower dry weight (21%) than the other treatments. There was a trend for Bayleton treated plants to have a smaller proportion flower dry weight (11%) although not significantly lower than the control plants.

Conclusions

The results of this study indicated Cycocel to be the most desirable of the tested height control materials for seed propagated tuberous begonia. Plant height was reduced 23% and discoloration of the foliage as reported by Kaczperski et al. (1989) after Cycocel treatments was limited at the studied rates. Flower number was slightly reduced with Cycocel but not to the extent

observed with Bonzi or Bayleton. No advantages were observed in using 1,000 ppm compared to 500 ppm Cycocel.

Although Bonzi and Bayleton applications resulted in the shortest plants of the study, shoot and flower numbers were also significantly lower than in the other treatments. A lower rate than 5 ppm Bonzi may provide a more preferable overall growth and development in begonia. Bayleton when used for powdery mildew control, may result in slow and stunted begonia growth especially if applied at an early plant stage.

B-Nine did not significantly reduce plant height at the studied application rates. However, B-Nine treated plants had significantly greater flower dry weight even though the number of flowers per plant was not different from the control.

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