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Tulip cultivar response to Flurprimidol preplant bulb soaks

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Abstract

Flurprimidol preplant bulb soaks (10 to 40 mg L^{-1}) were applied to tulip (*Tulipa* sp. L.) bulbs for growth control. Three tulip cultivars ('Page Polka', 'Prominence' and 'Red Present') were used to determine if the efficacy of flurprimidol varied by cultivar. Flurprimidol was compared to paclobutrazol (50 and 100 mg L^{-1}) and uniconazole (10 and 20 mg L^{-1}). Flurprimidol preplant bulb soaks significantly ($P \leq 0.05$) controlled tulip plant height during the greenhouse forcing when applied to 'Page Polka' and 'Prominence' at concentrations $\geq$ 15 mg L^{-1} and $\geq$ 10 mg L^{-1}, respectively. A concentration of 40 mg L^{-1} was needed to control plant height during the postharvest evaluation for 'Page Polka' while concentrations $\geq$ 15 mg L^{-1} controlled postharvest plant height for 'Prominence'. No control during forcing or postharvest was provided by any concentration tested on 'Red Present'. The differences observed indicate that the efficacy of flurprimidol as a preplant bulb soak varied with cultivars. In order to determine optimal cultivar doses, growers will need to conduct their own tulip cultivar trials, with flurprimidol concentrations ranging between 10 and 40 mg L^{-1}.

Key words: Paclobutrazol, piccolo, plant growth regulators, uniconazole

Introduction

During greenhouse production and postharvest blooming, plant growth regulators (PGRs) are often needed to control excessive stem stretch of tulips. A number of PGRs have been recommended for use on tulips. Ancymidol (α-cyclopropyl-α-(*p*-hmethoxyphenyl)-5-pyrimidinemethanol) (A-Rest, SePRO Corp., Carmel, IN) has been recommended by Dole and Wilkins (2005) as a substrate drench of 0.125 to 0.5 mg a.i. per pot, while Barrett (2002) recommended ancymidol substrate drenches of 1 to 5 mg L^{-1} per pot within the first two days of greenhouse forcing. Paclobutrazol [(±) -(R*,R*)-β-[(4-Chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol] (Bonzi, Syngenta, Greensboro, NC) drenches of 0.31 to 2.5 mg a.i. per pot or 1-h preplant bulb soaks in a 2 to 5 mg L^{-1} solution are recommended on the label. Tulips are listed on the uniconazole [(E)-(+)-(S)-1(4-chlorophenyl)4,4-dimethyl-2(1,2,4-triazol-1-yl)pent-1-ene-3-ol] (Sumagic, Valent USA, Marysville, OH) label, but no recommended concentrations are provided. In initial trials, flurprimidol preplant bulb soaks at a concentration of 25 mg L^{-1} for 10 min or substrate drenches of 0.5 mg a.i. per pot were recommended for the cultivar 'Prominence' (Krug *et al.*, 2004).

In previous experiments, only a single tulip cultivar was evaluated. Cultivar variations may occur as reported with sunflowers (*Helianthus annuus* L.) (Whipker and McCall, 2000) and hyacinth (*Hyacinthus orientalis* L.) (Krug *et al.*, 2006) or cultivar response may be similar as in geraniums (*Pelargonium ×hortorum* L.H. Bailey) (Whipker *et al.*, 2000). In order to provide guidelines for the use of flurprimidol preplant bulb soaks, a cultivar comparison trial was conducted with three cultivars of tulip.

Materials and methods

Noncooled tulip ('Polka', 'Prominence', and 'Red Present') bulbs were planted in 10.2 cm diameter plastic pots (575 ml) on 24 October, 2003. The root substrate was Berger BM 6 (Berger Peat Moss, St. Modeste, Quebec, Canada), which contained 75% to 80% Canadian sphagnum peat and 20 to 25% perlite. From date of potting to 5 January, 2004, bulbs were held at 5.0 ºC. On 5 January, 2004 the cooler temperature was lowered to 1.1 ºC. The bulbs were removed from the cooler on 4 February, 2004 at sunset and allowed to acclimatize overnight. Greenhouse forcing began on 5 February, 2004 with day/night set points of 20.0/18.3 ºC. Plants were forced under natural day length. The experiment was a completely randomized design with six single-plant replications of each of the 12 treatments for each of the three cultivars.

Plant growth regulators: On 24 October, 2003, the following treatments were applied as a preplant bulb soak for 10 min (in mg L^{-1}): flurprimidol (0.38%) at 10, 15, 20, 25, 30, 35, or 40; paclobutrazol (Piccolo, Fine Americas, Inc., Walnut Creek, CA) at 50 or 100; uniconazole at 10 or 20; and nontreated controls. Anthesis date (all petals fully colored and beginning to separate), and total plant height at anthesis (measured from the soil line to the uppermost part of the inflorescence) were recorded.

Postharvest study: Four plants, randomly selected from each treatment, were placed in a growth chamber with a temperature at 20.0 ºC after anthesis. Fluorescent bulbs provided light at 24 to 75 $\mu mol \cdot m^{-2} s^{-1}$ for a 12-h photoperiod. Plant height was recorded 10 d after anthesis.

Data analysis: Data were tested by analysis of variance (ANOVA) using general linear model (SAS Institute, Cary, NC) and means separation by least significant differences (LSD). Forcing and postharvest plant height values were regressed using PROC REG procedure to determine the best-fit, linear or quadratic, model. Terms of the model were evaluated for significance based on a comparison of F values at $\alpha = 0.05$. Models were compared to determine the best fit based on r^2 values.

Results and discussion

'Page Polka': Flurprimidol concentrations ≥ 15 mg L^{-1} controlled plant height, resulting in plants ≤ 14.0 cm tall, which was ≥ 21% shorter than the nontreated control (Fig. 1A). Paclobutrazol resulted in plants ≥ 19% shorter than the nontreated control at the concentrations tested. Plants were ≥ 22% shorter than the nontreated control when uniconazole was used at concentrations of 10 and 20 mg L^{-1}. Anthesis was not delayed by any of the treatments trialed (data not presented). During the postharvest evaluation plant height was controlled by flurprimidol at a concentration of 40 mg L^{-1} resulting in plants 29.0 cm tall, which were 20% shorter than the nontreated control. Paclobutrazol and uniconazole did not significantly ($P \geq 0.05$) control height during the postharvest evaluation at any concentration used. A concentration of 40 mg L^{-1} flurprimidol was needed to control postharvest stretch for 'Page Polka'.

'Prominence': Flurprimidol concentrations ≥ 10 mg L^{-1} controlled plant height, resulting in plants ≤ 16 cm tall, which was ≥ 20% shorter than the nontreated control (Fig. 1B). Paclobutrazol resulted in plants ≥ 28% shorter than the nontreated control at the concentrations tried. Plants were ≥ 23% shorter than the nontreated control with the concentrations of uniconazole used. Anthesis was not delayed by any treatment used (data not presented). During the postharvest evaluation plant height was controlled by flurprimidol at concentrations ≥ 15 mg L^{-1} resulting in plants ≥ 10% shorter than the nontreated control. Paclobutrazol at 100 mg L^{-1} controlled plant height during the postharvest evaluation resulting in plants 25.7 cm tall, which were 27% shorter than the nontreated control. Neither concentration of uniconazole (10 and 20 mg L^{-1}) controlled plant height during the postharvest evaluation. Based on regression analysis (Fig. 1B) a flurprimidol concentration of 38.3 mg L^{-1} would be required to obtain similar control as 100 mg L^{-1} paclobutrazol during the postharvest evaluation.

Previous trials by Krug *et al.* (2004) indicated that flurprimidol preplant bulb soaks at a concentration of 25 mg L^{-1} applied to 'Prominence' resulted in plants 32.8 cm tall during the postharvest evaluation. In this year's experiment, plants at postharvest evaluation were similar in height (31.3 cm) when treated with 15 mg L^{-1} flurprimidol preplant bulbs soaks. The amount of stem stretch which occurred in the cooler was greater in the initial experiment (Krug *et al.*, 2004) and may explain why 25 mg L^{-1} flurprimidol was needed then to obtain similar heights as the 15 mg L^{-1} recommended in this study.

'**Red Present**': None of the treatments of flurprimidol, paclobutrazol, or uniconazole controlled plant height during greenhouse forcing or the postharvest evaluation. Anthesis was delayed by 2.5 d ($P \leq 0.05$) when flurprimidol was used at a concentration of 40 mg L^{-1} (data not presented); however, this would not be considered commercially important. 'Red Present' is a short cultivar and PGRs would not be required to control postharvest stem stretch.

During greenhouse forcing flurprimidol preplant bulb soaks did not control height of the tulip cultivar 'Red Present'. Flurprimidol controlled greenhouse forcing height of tulip cultivars 'Page Polka' and 'Prominence' at concentrations of 15 and 10 mg L^{-1} respectively. When 'Prominence' tulip bulbs were treated with

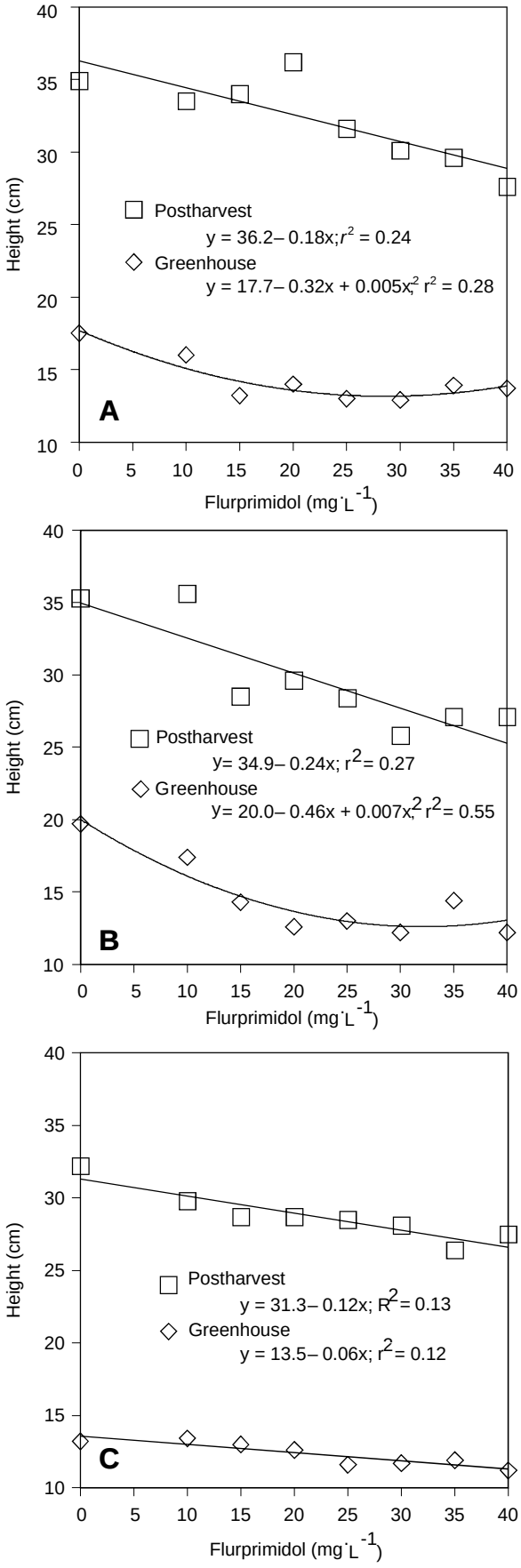

Fig. 1. The effects of flurprimidol preplant bulb soaks on tulip cultivars 'Page Polka' (A), 'Prominence' (B), and 'Red Present' (C) plant height at anthesis and during postharvest evaluation.

a 25 mg L^{-1} preplant bulb soak, plants were 32.8 cm tall, which were 28% shorter than the untreated control (Krug *et al.*, 2004). Flurprimidol preplant bulb soaks at 25 mg L^{-1} applied to 'Page Polka' and 'Prominence' resulted in plants 12% and 17%, shorter plants, respectively than the nontreated controls during the postharvest evaluation.

Differences in PGR efficacy among cultivars have been found with other bulb crops and PGRs. Optimal paclobutrazol preplant bulb soak recommendations for potted freesia range from 50 to 300 mg L^{-1} depending on the cultivar (DeHertogh, 1996). When paclobutrazol and uniconazole preplant bulb soaks were applied to Oriental and LA-hybrid lilies (*Lilium* L.), the response varied significantly among cultivars. Paclobutrazol preplant bulb soaks of 50 mg L^{-1} to 'Star Gazer' Oriental lily bulbs resulted in plants 9% shorter than the nontreated control, while the same concentration applied to 'Tom Pouce' lily resulted in plants 15% shorter than the nontreated control (Ranwala *et al.*, 2002).

Analysis of our results indicates that among tulips cultivar differences exist against flurprimidol efficacy as a preplant bulb soak during greenhouse forcing and the postharvest evaluation. However, the difference in efficacy during greenhouse forcing is usually not a concern for commercial producers as the plants are shipped to consumers before stem elongation occurs. Flurprimidol preplant bulb soaks at concentrations from 15 to 40 mg L^{-1} for tulip cultivars should be used for commercial production to control postharvest stem stretch. Growers will need to conduct on-site trials to determine the optimal concentration for individual cultivars of tulips.

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