

**Research Article**

## **Paclobutrazol Pre-Plant Bulb Dips Effectively Control Height of ‘Cilesta’ LA Hybrid**

**\*MR Dhiman**

*Indian Agricultural Research Institute*

*Regional Station, Katrain, Kullu-Valley (H.P.) – 175129*

*\*Author for Correspondence*

### **ABSTRACT**

The influence of pre-plant bulb dips in paclobutrazol solutions on final plant height, days to flower, and flower bud number were evaluated for LA hybrid. ‘Cilesta’ LA hybrid bulbs were dipped in solutions of paclobutrazol containing 0, 50, 100, 150 and 200 mgL<sup>-1</sup> for 10 min preceding planting. Increasing Pbz dose progressively reduced the height of ‘Cilesta’ hybrid by between 10% (84.65 cm; 50 mgL<sup>-1</sup>) and 36% (60.26 cm; 200 mgL<sup>-1</sup>) compared to control plants (94.55cm) however, neither the days to flowering nor days to end of flowering was modified. Based on these results, dipping LA hybrid bulbs in paclobutrazol solutions can be an effective strategy for reducing stem elongation without negatively impacting days to flower or flower bud length for commercially grown LA hybrids.

**Key words:** Bulb dip, chemical dwarfing, growth regulator, *Lilium* ‘Cilesta’ hybrid.

### **INTRODUCTION**

Interest in producing potted *Lilium* spp. plants has recently emerged among cut flower producers due to the increase in the popularity and hence the profitability of these species as potted plants. Apart from their relative ease of cultivation, the value of potted *Lilium* spp. plants per unit greenhouse surface area is high (Miller *et al.*, 1998). When producing bulb crops, height control is often required in order to obtain plants proportional to their pot size, to meet shipping requirements, and to reduce post-harvest stem elongation. An effective means of controlling plant height is to use plant growth regulators. Paclobutrazol (Pbz) {(+)-(R\*, R\*)-β-[(4-chlorophenyl) methyl]-α-(1, 1-dimethylethyl)-1H-1, 2, 4-triazol-1-ethanol} is commonly used with bulb crops in today’s floriculture industry (Krug, 2004). The pre-planting soaking of bulbs offers advantages over other application methods, such as time and labour savings, accuracy in dosage application, and its reasonable cost (Ranwala *et al.*, 2002). Many of the most vigorous lily cultivars traditionally grown for cut flowers can be raised in pots if growth regulators are used to obtain plants of a marketable size (Whipker and Hammer, 1993).

Some authors suggest an acceptable height for *Lilium* in pots to be 30-40 cm (Krug, 2004), while others suggest 20-50 cm (Beattie and White, 1993). However, many cultivars can grow to 50 or even 60 cm in height (De Hertogh, 1996). The use of Pbz to reduce plant height has already been tested in oriental hybrids by pre-planting bulb dipping for 30 min at concentrations of 100-200 ppm (Miller *et al.*, 1998; Dole and Wilkins,

1999). Ball and Miller (1996) demonstrated the effectiveness of this method with Pbz and other growth regulators (ancymidol and uniconazole) for the control of the height of *Lilium* L.A. hybrids. However, evidence has been found of a cultivar-dependent response, which emphasizes the need for appropriate dose adjustments (White, 1990; Ranwala *et al.*, 2002). The aim of the present work was to determine the effectiveness of Pbz on the control of the growth of popular LA hybrid of *Lilium* ‘Cilesta’ by dipping its bulbs in solutions of this growth regulator before planting.

### **MATERIALS AND METHODS**

This experiment was performed at the IARI, Regional Station, Katrain, during 2010-11. The non-vernalized bulb of LA hybrid ‘Cilesta’ was used. To mimic the cultivation conditions of most local flower producers, the experiment was undertaken without greenhouse temperature control. Paclobutrazol (commercial product Kultar SCTM, 25% active ingredient) was applied by dipping the clean bulbs in 1 L of 0 (water control), 50, 100, 150 or 200 mgL<sup>-1</sup> solutions – concentrations chosen according to the Bonzi<sup>TM</sup> and Sumagic<sup>TM</sup> pre-plant dip guidelines for a number of hybrid lily cultivars (Miller, 2003). The bulbs were placed in net bags (7 per treatment) and dipped in the treatment solutions for 10 min to promote uptake of solution and were then allowed to drain for 1 h. All bulbs were planted directly into 6 inch-diameter plastic pots (one per pot) at a depth of 8 cm. The substrate was a handmade mixture of 1:1:1 (FYM: Soil: Sand V/V). The electrical conductivity of

### Research Article

the media was  $0.29 \text{ mS cm}^{-1}$  and substrate pH was 6.5. The density of the pots on the greenhouse bench was approximately  $25 \text{ plants m}^{-2}$ . Growth and development data are shown in Table 1. Plants were inspected daily to check for damage and/or disease. Once the shoots were 5-7 cm tall, a liquid fertilizer of 20:20:20 (NPK) was applied at the rate of 200 ppm. The experiment had a randomised complete block design with three replicates. Each experimental unit contained 7 plants. Data were statistically analyzed by using *COSTAT* package and subjected to analysis of variance.

### RESULTS AND DISCUSSION

Plant height was shorter for all paclobutrazol-treated bulbs compared with control plants (Table 2). Height at flowering was suppressed by 10% to 36% compared with control plants as paclobutrazol concentration increased from 50 to  $200 \text{ mgL}^{-1}$  (Table 2). Soaking bulbs in a  $200 \text{ mgL}^{-1}$  paclobutrazol solution resulted in plants that were 60.26 cm tall at flowering (Table 2), which met the target height range of 48 to 56 cm for potted, flowering lily (Miller, 1992). Neither days to emergence nor days to flower and flower bud length were affected by paclobutrazol applications (Table 2).

Our results on the impact of paclobutrazol on height and days to flower are in agreement with previous work using paclobutrazol sprays or drenches with Easter lily, or paclobutrazol bulb dips with hybrid lilies (Francescangeli *et al.*, 2007; Jiao *et al.*, 1986; Ranwala *et al.*, 2002). Ball and Miller (1996) reported a stronger effect of Pbz on the *Lilium* L.A. hybrid 'Royal Fantasy'; 10 min dips reduced the height at flowering by 53% at 100 ppm and 66% at 150 ppm.

The days to emergence, number of days to anthesis, length of 2<sup>nd</sup> flower bud and days to end of flowering of 'Cilesta' were unaffected by paclobutrazol. Jiao *et al.*, (1986) reported that applying 2.0 to 6.0 mg/pot paclobutrazol suppressed 'Nellie White' plant height by 19% to 42% compared with untreated plants, but did not affect days to flower or flower number. Our results are similar to those using paclobutrazol bulb dips for oriental and LA-hybrid lilies (Francescangeli *et al.*, 2007; Ranwala *et al.*, 2002). Ranwala *et al.* (2002) demonstrated that dipping bulbs in 50 to 300 ppm paclobutrazol solutions was effective in suppressing height for 14 oriental hybrid and LA-hybrid lilies, although the concentration required for height suppression varied with cultivar. Flowering was delayed up to 4 days for 'Casa Blanca' dipped in 200 or  $300 \text{ mgL}^{-1}$ , yet most cultivars were unaffected by paclobutrazol; flower number of any cultivar was unaffected by paclobutrazol (Ranwala *et al.*, 2002). Final height of 'Ercolano' and 'Royal Prospect' LA-hybrid lily was 29% to 45% and 45% to 59% shorter, respectively, compared with untreated plants as paclobutrazol concentration increased from 50 to 150 ppm. Days to flower of 'Ercolano' was unaffected by treatment, and while soaking 'Royal Prospect' bulbs in 150 ppm paclobutrazol did significantly delay days to first open flower by one day compared with untreated plants (Francescangeli *et al.*, 2007). The number of flower buds of 'Ercolano' and 'Royal Prospect' were unaffected by any treatment (Francescangeli *et al.*, 2007). These results, combined with our findings, indicate that paclobutrazol bulb dips are an effective method of controlling height of oriental, LA hybrid, and Easter lilies.



**Figure 1:** Differential response by *Lilium* hybrid 'Cilesta' to Paclobutrazol. From left to right: appearance of plants at the stage of full bloom after bulb soaking in 0, 50, 100, 150 and  $200 \text{ mg L}^{-1}$  paclobutrazol respectively for 10 min.

**Research Article**

**Table 1: Definitions of Lilium hybrid growth and flowering variables**

Variables	Description
<i>Growth stages after planting</i>	Emergence: visible appearance of the flower sprout
Days to emergence	Tips of flower bud visible to the naked eye
Days to visible flower buds	Flower bud with separated tip petals
Days to first open flower	End of flowering defined as when the last open flower shows areas of minimum wilting at the petal edges
Days to end of flowering	
<i>Plant height and number of flowers</i>	Total plant height reached by either the leaves or flowers without modifying their natural position
Total plant height	Number of flower buds completely formed
Number of flower buds	Length of the second flower bud when completely formed but still closed
Length of the second flower bud	

**Table 2: The effect of soaking ‘Cilesta’ LA lily bulbs in paclobutrazol solutions containing 0, 50 ,100, 150 and 200 mg L<sup>-1</sup> for 10 min before planting on final plant height and different flowering variables.**

Paclobutrazol treatments (mg L <sup>-1</sup> )	Days to emergence (days)	Days to visible bud formation (days)	Days to 1 <sup>st</sup> flowering (days)	Days to end of flowering (days)	Number of flower bud	Length of 2 <sup>nd</sup> bud	Plant height (cm)
Control	141.0	200.4	236.7	3.5	2.1	11.7	94.5
50	135.4	204.4	237.7	5.7	1.4	11.7	84.6
100	137.4	201.0	235.5	5.5	1.9	11.7	87.9
150	139.8	200.2	236.5	5.2	2.2	12.1	79.1
200	139.2	202.1	236.8	5.3	2.4	11.6	60.2
<b>CD (P=5%)</b>	<b>NS(3.72)</b>	<b>1.55</b>	<b>2.19 (NS)</b>	<b>2.17 (NS)</b>	<b>0.39</b>	<b>0.56(NS)</b>	<b>8.65</b>

**CONCLUSION**

Paclobutrazol is effective in reducing stem elongation of ‘Cilesta’ LA hybrid when applied as a bulb dip. Additionally, bulbs dipped in 200 mgL<sup>-1</sup> paclobutrazol for 10 min flowered within the commercially acceptable specified range of heights without affecting the flowering variables (Fig. 1). Applying paclobutrazol to lily bulbs using a bulb dip can reduce labor and chemical costs when compared with spraying plants or drenching media. However, the concentration of paclobutrazol should be adjusted according to the hybrid grown.

**REFERENCES**

**Ball J P and Miller WB (1996).** Pre-plant bulb dips for height control of L.A. hybrid lilies. *SNA Research Conference*, **41**:20-23.

**Beattie DJ and White JW (1993).** *Lilium*: hybrids and species. In: The physiology of flower bulbs (DeHertogh A., Le Nard M., eds). Elsevier, Burlington, MA, USA. 423-454.

**De Hertogh A (1996).** *Lilium* (Asiatic and Oriental hybrids) potted plants. In: Holland bulb forcer’s guide. The International Flower Bulb Centre, Hillegom, The Netherlands. C109-C121.

**Dole JM and Wilkins HF (1999).** *Lilium*, Asiatic and Oriental. In: Floriculture principles and species. Prentice Hall, Upper Saddle River, NJ, USA. 408-416.

**Francescangeli N, Marinangeli P and Curvetto N (2007).** Paclobutrazol for height control of two *Lilium* L.A. hybrids grown in pots. *Spanish Journal of Agricultural Research* **5** 425-430.

**Research Article**

**Jiao J, Tsujita M J and Murr D P (1986).** Effects of paclobutrazol and A-rest on growth, flowering, leaf carbohydrate and leaf senescence in Nellie White Easter lily (*Lilium longiflorum* Thunb.) *Scientia Horticulture* **30** 135-141.

**Krug BA (2004).** The chemical growth regulation of bulb crops using flurprimidol as foliar sprays, substrate drenches, and pre-plant bulb soaks. Master's degree thesis, North Caroline State University, Raleigh, USA.

**Miller WB (2003).** Height control in lilies. *Flora Culture International* **13** (5) 18-23.

**Miller WB, Miller R and Miller R O (1998).** *Lilium* (Asiatic and Oriental lilies). In: Ball Redbook (V. Ball, ed). Ball Publishing, Batavia, III. USA. 600-606.

**Miller WB (1992).** Easter and hybrid lily production. Timber Press, Portland, OR.

**Ranwala AP, Legnani G, Reitmeier M, Stewart B B and Miller WB (2002).** Efficacy of plant growth retardants as pre-plant bulb dips for height control in LA and oriental hybrid lilies. *Horticulture Technology*, **12** 426-431.

**Whipker BE and Hammer PA (1993).** Research report: Oriental lily growth regulator study. Floriculture Indiana Purdue University Horticulture Department Cooperation Extension. Service, **7** 10-16.

**White JW (1990).** Garden bulb crops as pot plants using growth regulators. *Bulletin Pennsylvania Flower Growers*, **402** 1-4.