HortScience 23(2):359–360. 1988.

Influence of Paclobutrazol on the Growth and Flowering of *Camellia* x *Williamsii*

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Additional index words. ICI-PP333, growth retardants

Abstract. **Plant height and lateral shoot growth of *Camellia* x *Williamsii* 'Waterlily' and 'Debbie' were controlled effectively by foliar sprays or media drenches of paclobutrazol. A single foliar application of 500 mg·liter^{-1} paclobutrazol reduced height of both cultivars by ≈30%, and plants were considered commercially acceptable. The response did not carry over into subsequent years. Some rates of paclobutrazol increased the total number of open flowers, but there was a varied effect on flower abscission. Paclobutrazol treatment could prove a useful technique for the commercial production of camellias for temporary use as indoor flowering pot plants before subsequent planting in the landscape. Chemical name used: β-[(4-chlorophenyl)methyl]-α-(1,1-dimethylethyl)-1*H*-1,2,4-triazole-1-ethanol (paclobutrazol, ICI-PP333).**

Camellia x *williamsii* hybrids have large, impressive flowers and offer great potential to be used as flowering pot plants. However, most cultivars lack a compact growth habit, and the long stems usually droop under the weight of the flowers. To exploit fully the potential of these cultivars for use as flowering pot plants, stem length must be controlled. In addition, an increase in the number of flowers that open simultaneously would be beneficial in many cultivars (4).

Paclobutrazol, a plant growth regulator, has been reported to retard stem elongation and, in some instances, promote flowering within a broad range of species (1, 5, 6). In addition, other growth regulators known to act as gibberellic acid antagonists can promote flowering in camellia (2, 4). The purpose of this investigation was to test the efficacy of paclobutrazol to promote flowering and compactness in two popular camellia hybrids, 'Waterlily' and 'Debbie'.

Commercially rooted cuttings ≈20 cm in length were obtained in autumn and immediately potted into 12-cm-diameter pots containing 4 pine bark : 1 brown coal (Lignite) : 1 coarse sand (by volume). Fertilizer was added at a rate of 1 kg Osmocote (15N–5.2P–12.5K), 2 kg Osmocote (18N–4.8P–8.3K), 2 kg dolomite, and 1 kg Micromax per cubic meter of mix. Ten days after repotting, all main shoots were hand-pinched to induce side shoot development. The plants were grown for 14 weeks in 50% shade (maximum light level fo 450 μmol·s^{-1}·m^{-2}) before being transferred to a whitewashed polythene tunnel (maximum light level 800 μmol·s^{-1}·m^{-2}). Every 3 months, each pot was top-dressed with an additional 6 g of Osmocote (18N–4.8P–8.3K).

The few plants (<15%) that flowered in the first spring were excluded from the experiment. Camellias usually have two short periods of active growth each year, typically one in spring and another in autumn. Treatments were applied when the spring flush shoots had reached 5 to 7 cm and the mean plant height was 33 cm for 'Waterlily' and 42 cm for 'Debbie'. Paclobutrazol was sprayed to runoff (10 ml/plant) at 500 mg·liter^{-1} (a.i.) either as a single application or with an additional application 8 days later. In addition, a drench treatment applied at 20 mg (a.i.) per pot in 80 ml of water to moist medium was included. Control plants received no paclobutrazol. After 17 weeks, all plants were repotted into 15-cm-diameter pots using the same potting mix and fertilizer levels as previously described.

The experimental design was a completely randomized block with four single plant replicates per treatment. The number of immature flower buds, plant height, lateral shoot growth, and the total number of fully opened flowers were measured and recorded 40, 45, and 56 weeks, respectively, following treatment. To assess any prolonged carryover effects of paclobutrazol, the most recent shoot growth (the new spring growth flush) was measured 59 weeks after treatment.

All paclobutrazol treatments significantly reduced plant height and lateral shoot growth in both cultivars 45 weeks after treatment (Table 1). Compared with the control, only the single 500 mg·liter^{-1} spray treatment produced a level of stem growth and height reduction (25% to 50%) for both cultivars that was considered commercially acceptable. At this rate, stem drooping was controlled adequately, and plants developed an acceptable compact appearance (Fig. 1). Stem growth reductions in the other paclobutrazol treatments were considered excessive for commercial recommendation.

Although there was evidence with the drench (20 mg/pot) that growth retardation persisted into the following year, no such carryover effects were evident for either of the spray treatments (Table 1).

Paclobutrazol application previously has been reported to increase flower bud numbers in other ornamental plant species (1, 6). The present results show that the effect of paclobutrazol on camellia flowering was different for the two cultivars and, to some extent, depended on the mode of application. Generally, paclobutrazol significantly increased the early development of flower buds. Spray treatments on 'Debbie' were particularly effective, approximately doubling flower bud numbers compared to the control. Flower bud abscission in camellias is normally high (up to 50% in some cultivars) (3), and this abscission also occurred for all treatments in this experiment. However, the paclobutrazol drench treatment appeared to exacerbate this tendency, so much so in 'Debbie' that nearly all flower buds either failed to open or were shed prematurely. Taking into account flower bud initiation and premature abscission, the

Table 1. Effect of paclobutrazol on vegetative growth and flowering of two camellia cultivars.

Treatment	Plant ht (cm)	Shoot length (cm)	Spring stem growth (59 weeks) (cm)	Flower bud no.	Fully opened flower no.
			'Waterlily'		
Control	62.0 a[z]	99.5 a	345.3 a	14.0 b	11.8 a
Paclobutrazol					
Spray					
1 × 500 mg·liter^{-1}	47.3 b	50.9 b	317.0 a	21.8 ab	14.0 a
2 × 500 mg·liter^{-1}	45.3 b	32.9 bc	284.5 a	27.0 ab	15.3 a
Drench					
20 mg/pot	40.5 b	21.5 c	144.5 b	29.3 a	13.5 a
			'Debbie'		
Control	88.5 a	110.0 a	237.0 a	17.0 c	12.8 c
Paclobutrazol					
Spray					
1 × 500 mg·liter^{-1}	58.0 b	78.4 b	193.3 a	37.0 a	24.5 a
2 × 500 mg·liter^{-1}	49.8 b	33.1 c	224.8 a	32.5 ab	18.3 b
Drench					
20 mg/pot	48.8 b	13.1 d	126.8 a	23.8 bc	1.3 d

[z]Mean separation in columns for each cultivar by Duncans multiple range test, 5% level.

Received for publication 10 Apr. 1987. We thank ICI Australia for providing paclobutrazol and D. Fontana for technical assistance. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

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Fig. 1 The effect of one foliar application of 500 mg·liter^{-1} paclobutrazol on growth and flowering of 'Waterlily' camellia 56 weeks after treatment.

overall effect of paclobutrazol on the number of fully opened flowers was largely cultivar-dependent. None of the paclobutrazol treatments affected the final number of open flowers for 'Waterlily'. However, for 'Debbie', spray treatments increased, whereas the drench treatment severely decreased, open flower number.

The present results indicate that a single spray application of paclobutrazol at a concentration of 500 mg·liter^{-1} would control excessive vegetative growth of camellias. The production of compact plants in this way may enable the temporary use of flowering camellias as attractive indoor pot plants. With at least some cultivars, an additional benefit of increased flower numbers could result from paclobutrazol treatment. An absence of any appreciable long-term growth retardation in the recommended treatment would suit the subsequent use of these plants in the garden, after their house-life is over.

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HortScience 23(2):360–362. 1988.

Growth Potential of the Easter Lily Bulb

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Additional index words. *Lilium longiflorum,* sink, source, photosynthesis

Abstract. **Removing 33% or 100% of the Easter lily (*Lilium longiflorum* Thunb. 'Nellie White') mother scales when flower buds were 1.3 cm in length, in conjunction with flower bud removal at the 3-cm stage, increased daughter bulb dry weight by 21% and 45%, respectively, when plants were harvested after 13 weeks. Size of the remaining mother scales in partially de-scaled plants was estimated to be 30% larger than their counterparts in intact bulbs. Growth of the Easter lily bulb is likely limited by source carbon supply.**

Research has shown that the growth of storage organs in several bulbous crops may be limited by carbon supply from the source. Flower removal and delayed leaf senescence increased the final bulb yield in tulip (6). Decreasing competition for carbon by removing Easter lily flower buds when the first buds on plants reached 3 cm in length increased final bulb size (8, 9). In the following study, carbon sinks in Easter lily plants were modified to determine the growth potential of the daughter and mother bulb scales.

Yearling *Lilium longiflorum* Thunb. 'Nellie White' bulbs, 30 to 40 g in fresh weight, were grown in 15-cm clay pots during the 1982–83 season as previously described (8). When the first flower buds averaged 1.3 cm in length (shortly before the visible bud stage), 0% (control), 33%, or 100% (0, 2.5, and 7.7 g in dry weight, respectively) of mother scales were removed. Six bulbs were harvested in order to determine the amount of 33% mother scales to be removed. Plants were removed from pots, keeping the soil mass intact. A hole was made on each of the opposite sides of soil in order to reach the bulb and remove the mother scales. The soil then was replaced and plants were returned to their original pots. Root systems of control plants were left undisturbed.

Flower buds on treated plants were removed after 3 weeks, when the first buds on plants reached 3.5 cm in length, so removal of these active carbon sinks would not interfere with dry matter production and leaf net photosynthesis, as determined previously (8, 9). Flower buds on control plants were allowed to reach full bloom, maximizing carbon competition with the bulb scales. Net photosynthesis of the upper fifth and 25th leaves was monitored at irregular intervals using the CO_2 depletion technique described elsewhere (1, 8).

Six plants in each treatment were harvested when anthesis occurred on control plants (6 weeks after scale removal); the other six were harvested 7 weeks after anthesis. At harvest, stem length (from the base to the uppermost leaf node), pedicel length, leaf area, and number of daughter primordia were recorded. Dry weights of shoot, roots, daughter and mother scales (when present), and stem bulblets were determined. There

Received for publication 8 June 1987. Texas Agricultural Experiment Station technical publication no. 22786. This work was conducted at the Dept. of Horticulture, Oregon State Univ. Easter lily bulbs were donated by Pacific Bulbs Growers' Research and Development Station, Harbor, Ore. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

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