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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Growth Potential of the Easter Lily Bulb

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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

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Table 1. Effect of partial and complete removal of mother scales on Easter lily plant and bulb growth (1982–83)[z].

Mother scale removal (%)	Stem length (cm)	Pedicel length (cm)	Leaf area (cm^2)	Dry wt (g) Shoot	Root	Bulb: Mother scales	Bulb: Daughter scales	Stem bulblets	Flowers	Whole plant	No. daughter primordia
						At scale removal					
0	10.8	---	393	3.6	1.7	7.5	0.2	0	0.1	13.6	35
						At anthesis					
0	16.3	12.6	652	7.8	4.8	9.2 (0)[y]	1.0	0	3.5	26.3	50[w]
33	15.7	2.8	570	6.0	2.2	6.9 (2.5)	2.5	0	0.6	18.2 (20.7)[x]	53
100	15.4	3.2	565	6.3	2.7	0 (7.7)	3.3	0.1	0.6	13.0 (20.7)[x]	53
$LSD_{0.05}$	NS	0.5	NS	0.8	1.4	1.0	0.6	0.0	0.2	3.5	NS
						7 weeks after anthesis					
0	17.8	12.9	---	10.0	4.3	12.3	8.4	0.8	3.6	39.4	70[w]
33	17.7	3.5	---	8.0	3.9	9.2	10.2	1.1	0.7	33.0 (35.5)[x]	71
100	15.4	3.5	---	6.8	3.4	0	12.2	1.7	0.6	24.7 (32.4)[x]	72
$LSD_{0.05}$	0.8	0.6		1.2	NS	2.7	1.2	0.5	0.1	4.8	NS

[z]Flower buds on treated plants were removed 3 weeks following treatment. Flower buds on control plants were allowed to bloom.
[y]Weight of severed mother scales.
[x]Weight of whole plant and excised mother scales.
[w]Sum of scale and leaf primordia.

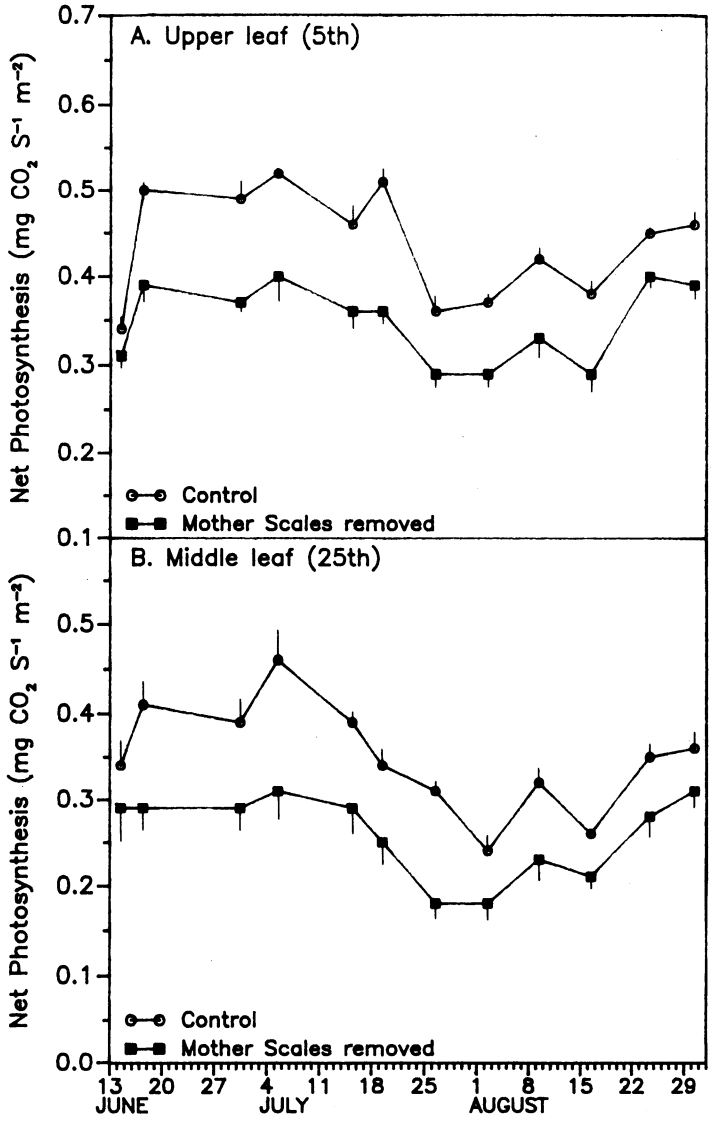

Fig. 1. The effect of removing flower buds and all of the mother scales on net photosynthesis of the fifth (**A**) and 25th (**B**) leaf from the top of Easter lily plants. Bar at each data point represents SE of the mean (1982–83).

were three flowers or buds on each plant. This experiment was in a randomized complete block design with one plant representing an experimental unit replicated six times.

Partial and complete removal of mother scales had minimal effect on stem elongation (Table 1), suggesting that stem growth was not dependent on scale reserves at the time of scale removal (10). Leaf area reductions in both treatments were similar (12%), but not significantly different from the control, despite partial and complete removal of mother scales. Therefore, the decreased leaf expansion was probably due to damage to the root system rather than to reduced carbon supply from the mother scales. It was found previously that bulbs had stopped losing dry weight before flower buds became visible (11). Nearly half of the roots on treated plants had died and decomposed when anthesis occurred. Shoot dry weight decreased in treated plants due to shorter pedicels (Table 1) as a result of flower bud removal (8).

Daughter bulbs were small and had only 0.2 g dry weight when treatments were initiated. When harvested at anthesis, growth of the daughter bulbs already was greatly enhanced by the removal of mother scales and flower buds, as indicated by their increased dry weights (Table 1). A previous report showed that growth of the daughter bulb was limited by its capacity to take up carbon at a stage when the first flower bud was 3 cm long (9). These results suggest that growth of the daughter bulb for a period during the 3 weeks before anthesis was likely limited by carbon supply.

At final harvest, partial and complete mother scale removal, in conjunction with removing flower buds, caused the daughter bulbs to be 21% and 45% larger than the control, respectively (Table 1). However, dry matter accumulation in daughter scales of plants having one-third of the mother scales removed was similar to controls during the last 7 weeks, probably due to the competition for carbon with the remaining mother scales and restoration of the root systems during this period. Apparently the damaged root systems did not affect bulb filling adversely because bulbs that received partial scale removal had slightly heavier dry weight (weight of excised mother scales included) than the controls.

Number of daughter primordia was not af-

Table 2. Effect of complete mother scale removal on Easter lily plant (1983–84).

Part removed	Leaf area (cm^2)	Dry wt (g) Daughter scales	Mother scales	Stem bulblets
Control	766	13.2	19.7	2.3
Mother scales	711	19.3**	2.1[z]**	3.0*

[z]Residual mother scales.
*,**Significantly different at the 5% and 1% levels, respectively, F test.

fected by scale and flower bud removal or by increased carbon supply from the leaves, indicating that the larger daughter bulbs in treated plants were the result of increased individual scale size. However, reduced carbon supply to the bulb as a result of severe leaf removal reduced the rate of daughter primordia initiation (7).

Mother scales in control plants and in plants with two-thirds of their mother scale complement had gained 4.8 and 4.2 g of dry matter, respectively, at final harvest (Table 1). Because these modified plants had 33% fewer mother scales, the dry weight of these scales was estimated to be ≈30% larger than their counterparts in the control bulb.

Net photosynthesis of the fifth and 25th leaves on plants without mother scales was much lower than the control (Fig. 1) throughout the period monitored. These plants also had smaller total plant dry weights, even when dry weights of the removed mother scales were included (Table 1). Decreased photosynthesis as a result of reduced sink demand also was observed in potato (4), pea (2), strawberry (3), and wheat (5) after partial or complete sink removal. The results suggest that the canopy photosynthetic capacity of plants without mother scales might have exceeded the carbon demand of the daughter bulbs. Hence, the 45% weight increase in daughter bulbs of these plants could have been their maximum growth potential, despite the damaged root systems and slightly reduced leaf areas.

A similar experiment was conducted the following year (1983–84 growing season). Treatment involved only the complete removal of mother scales when flower buds had reached 3.0 cm in length (7), so it had no impact on leaf expansion (Table 2). Fractions of residual mother scales were found on bulbs at harvest. To create a competing sink, flower buds on treated plants were not removed. When harvested 13 weeks after treatment, the increase in daughter bulb dry weight, 45% over control (Table 2), was similar to that in the previous experiment. Increased daughter bulb size in this second experiment was probably due to the use of large (40- to 50-g) planting stocks.

Growth of stem bulblets was not greatly enhanced by partial or complete removal of mother scales (Tables 1 and 2). Easter lilies grown in pots generally do not form as many stem bulblets as plants in the field, possibly due to restricted rooting space and growth of the stem roots, depth of planting, limited nutrient uptake, etc., unless the whole bulb is removed (data not shwon). Because stem bulblets represent a tremendous carbon sink (10), selecting Easter lily clones with few or no stem bulblets and using tissue-cultured bulblets as planting stock may be a possible avenue to increase bulb size.

Although bulb weight increased by 30% when flower buds are removed at the 3-cm stage (7), an Easter lily bulb has the potential to grow even larger when ample carbon is provided. In the production field, growth of an Easter lily bulb seems to be limited by the source carbon supply and probably never reaches its maximum potential.

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