

Effect of Precooling and Ethylene Absorbent on the Quality of *Dendrobium* 'Pompadour' Flowers

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Keywords: flower drop, ethylene absorbent, orchid flower, precooling, vase life

Abstract

We studied the effect of precooling and the use of an ethylene absorbent (based on potassium permanganate) in the flower boxes, on the vase life of *Dendrobium* 'Pompadour' flowers, after simulation of air shipment (3 days at 25°C). Precooling at 10°C (85-95%RH) for 60 minutes reduced ethylene production, ACC activity, and the concentration of 1-aminocyclopropane-1-carboxylic acid (ACC) in the flowers, during shipment. Precooling for 90 minutes or longer did not have a positive effect on the chilling-sensitive *Dendrobium* flowers. The presence of an ethylene absorbent in the cardboard boxes further reduced ethylene concentration in the boxes. The combination of 60 min precooling and the ethylene absorbent was optimal to reduce epinasty of the buds and flowers, to promote bud opening and to prevent abscission of open flowers. It also considerably delayed the time to in visible petal withering.

INTRODUCTION

Dendrobium flowers of most cultivars last for several weeks if they remain attached to the mother plant, and are not pollinated. In contrast, floral life after harvest is short, depending on environmental conditions during holding and shipment (Nair, 1984). A small rise in ambient ethylene levels, for example, results in early senescence and abscission of both floral buds and open flowers (Reid and Wu, 1992). Although *Dendrobium* flowers produce only little ethylene (Ketsa and Thampitakorn, 1995), the ethylene level in cardboard boxes during shipment becomes high enough to induce these adverse effects. In order to reduce postharvest problems, we investigated the effects of precooling and the use of an ethylene absorbent on the vase life of *Dendrobium* 'Pompadour' flowers. We thereby simulated air shipment.

MATERIALS AND METHODS

Inflorescences of *Dendrobium* 'Pompadour' were purchased from a commercial grower near Bangkok. Export grade inflorescences, with 5-7 open flowers and 5-10 flower buds, were selected for freshness and uniformity. Peduncles of individual inflorescences were recut to 12 cm from the lowermost open flowers. Stem ends of individual inflorescences were inserted in plastic tubes containing water. Inflorescences were held at 10°C (85-95%RH) for 0, 30, 60, 90 and 120 minutes before packing in cardboard boxes and were then kept at 25°C (85%RH) for 3 days (simulated air transport). The concentration of ethylene inside the boxes was monitored. Ethylene production, ACC content and ACC synthase activity of open flowers and flower buds were determined using the methods described by Hoffman and Yang (1982) and Lizada and Yang (1979). At the end of simulated shipment, freshness, wilting, and abscission of flower buds and open flowers were recorded. Individual inflorescences were recut in air (removing 1 cm) and placed individually in 10 ml centrifuge tubes containing water, and were placed at room temperature (28°C). RH was about 70%. The time to wilting or abscission of open flowers, as well as the percentage epinasty and bud opening were

recorded daily. Abscission and bud opening were expressed as a percentage of the total number of open flowers and buds, respectively.

An ethylene absorbent, was made by soaking pieces of chalk (0.7 cm diameter, 0.5 cm long) in saturated potassium permanganate solution. 50 g of the dried material was placed in perforated polyethylene sachet. The sachets of EA were placed inside cardboard boxes after precooling.

RESULTS

Precooling for 60 min gave a longer vase life and in most experiments it promoted bud opening (Tables 1 and 2). In the experiment shown in Table 2 bud opening was high and no effect of precooling was observed (results not shown). Precooling had no obvious effect on abscission of open flowers (Table 2) and no effect on bud abscission (results not shown). As can be noted from the two tables, various batches of flowers show a considerable difference in vase life.

Precooling reduced ethylene concentrations in the boxes (Fig. 1) and reduced ethylene production, although much more so in flower buds than in open flowers (Fig. 2). ACC content and ACC synthase activity of precooled orchid flowers were lower than those without precooling (Fig. 3).

Precooling for 60 minutes was optimal. A longer duration of precooling (90 minutes or more) had less effect on vase life, ethylene concentration and ethylene production. This was apparently due to chilling injury (results not shown).

Placement of an ethylene absorbent inside the boxes further reduced the ethylene concentration in the air (Fig. 1). The combination of precooling and the ethylene absorbent produced a longer vase life and resulted in less flower abscission, compared to the boxes that were only precooled or only treated with the ethylene absorbent (Table 2). Epinasty, common in the peduncles of floral buds and open flowers, was also considerably reduced by the combined treatment (results not shown).

DISCUSSION

It has been recorded previously that *Dendrobium* flowers wrapped in plastic film and packed in cardboard boxes produce enough ethylene to result in early wilting and abscission (Davidson, 1971). We have previously shown that flower buds of *Dendrobium* produce more ethylene than open flowers, during such shipment (Ketsa and Thampitakorn, 1995; Ketsa and Prayuravong, 2001). We attempted to find a method to prevent ethylene accumulation in the flower boxes. Precooling for 60 min resulted in low ethylene production, and increased bud opening and the time to flower wilting. Precooled orchid flowers had lower ACC content and lower ACC synthase activity than flowers that had not been precooled. This suggests that precooling reduced ethylene production, at least partially, through inhibition of ACC synthase.

Placement of an ethylene absorbent further reduced ethylene concentrations in the boxes. It produced a longer vase life and less flower abscission. It also produced less epinasty. The data suggest that *Dendrobium* flowers can be precooled, if not too long. Inclusion of an ethylene absorbent in the boxes further protected the flowers during shipment, and can therefore add to flower quality.

ACKNOWLEDGEMENTS

The research was financially supported by the Postgraduate Education and Research Development Project in Postharvest Technology and the Thailand Research Fund.

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Tables

Table 1. Vase life and bud opening of *Dendrobium* 'Pompadour' flowers after room cooling at 10°C for 60 min, then packed in cardboard boxes for 3 days at 25°C (simulated shipment), and evaluation of vase life at room temperature (28°C). Bud opening was determined at the end of vase life, and compared to the beginning of precooling.

Treatment	Vase life ¹ (days)	Bud opening ² (%)
Without precooling	11.9 b	38.2 b
With precooling	14.9 a	79.6 a
<i>t</i> -test	*	**

^{1,2} Mean comparison by *t*-test, * = significant at 95% level and ** = significant at 99% level

Table 2. Vase life and abscission of open flowers in *Dendrobium* 'Pompadour' flowers after room cooling at 10°C for 60 min, then packed in cardboard boxes for 3 days at 25°C (simulated shipment), and evaluation of vase life at room temperature (28°C). Abscission of open flowers was determined at the end of vase life, and compared to the beginning of precooling.

Treatment	Vase life ¹ (days)	Abscission ² (%)
Without precooling	5.9 c	7.5 a
With precooling	6.8 b	7.5 a
Without precooling + EA	6.1 c	2.5 b
With precooling + EA	8.4 a	0.0 c
<i>F</i> -test	*	**

^{1,2} Mean comparison by DMRT, * = significant at 95% level and ** = significant at 99% level

Figures

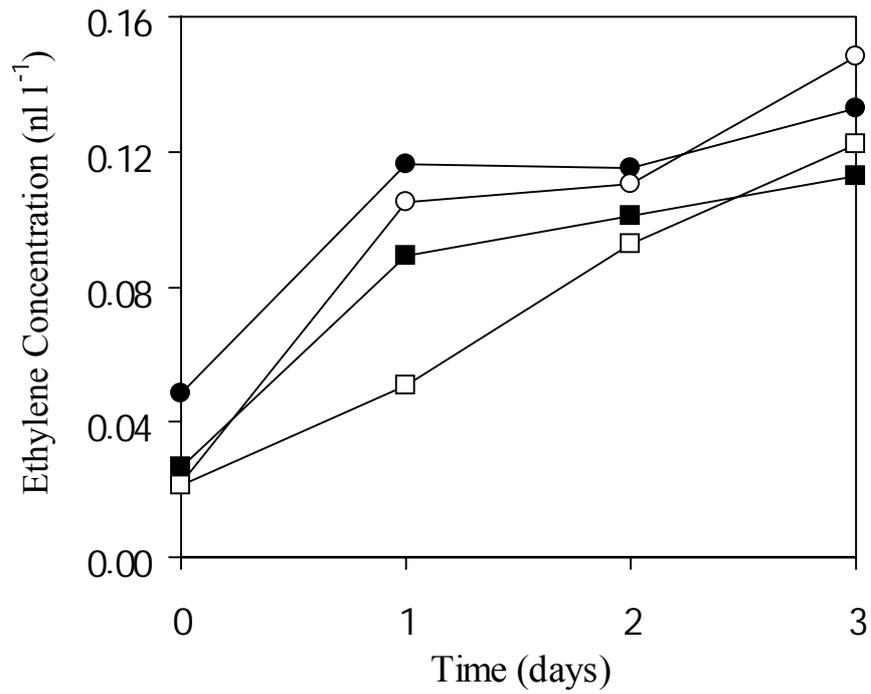


Fig. 1. Ethylene concentrations within cardboard boxes containing *Dendrobium* 'Pompadour' flowers, with (○, □) and without (●, ■) ethylene absorbent and precooling (□, ■) for 60 min. Precooling preceded time 0. LSD was less than 1% of the scale.

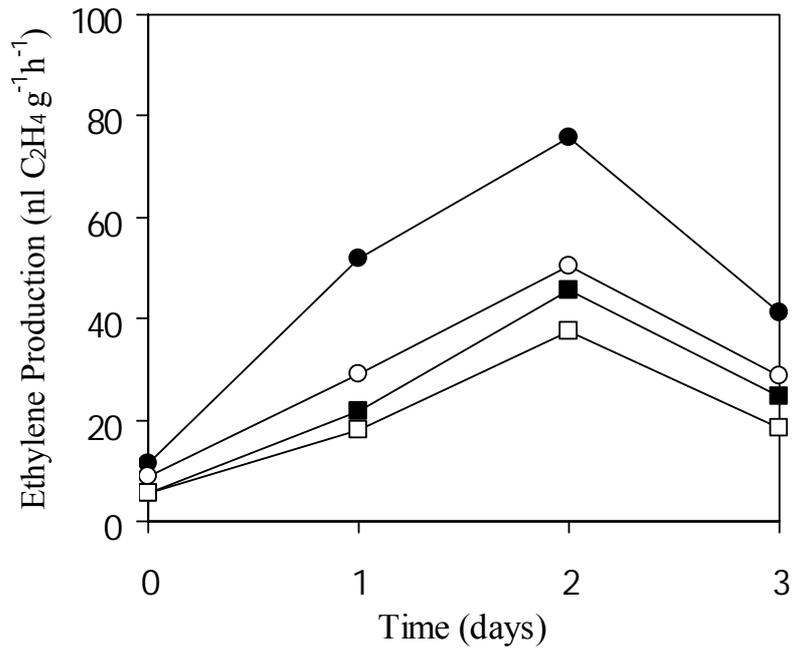


Fig. 2. Ethylene production of flower buds (○, ●) and open flowers (□, ■) of *Dendrobium* 'Pompadour' flowers with (○, □) and without (●, ■) precooling for 60 min. LSD was less than 3% of the scale.

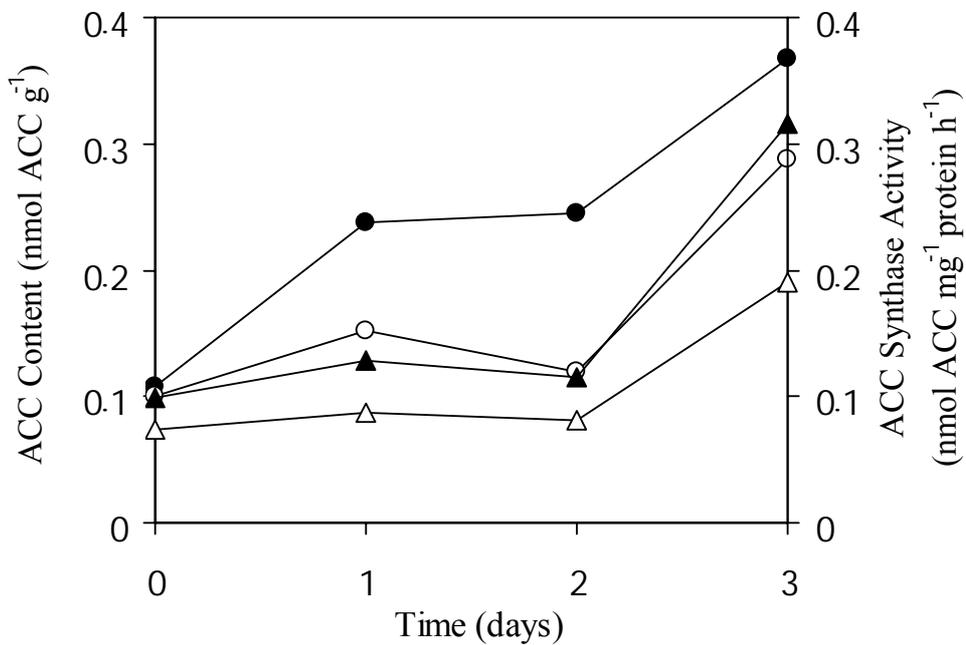


Fig. 3. ACC content (○, ●) and ACC synthase activity (△, ▲) of *Dendrobium* 'Pompadour' flowers with (○, △) and without (●, ▲) precooling for 60 min. LSD was less than 3% of the scale.

