Pretreatment with 1-methylcyclopropene (1-MCP) reduced the flower abscission in *Phaleonopsis* cut orchid

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Abstract*—Phaleonopsis cut orchids were pretreated for 6 hours at 25 °C with or without 1-MCP. Treated cut orchids were exposed to 800 ppm of 1- methylcyclopropane (1-MCP). Then, all cut flowers were treated with ethylene for 15 hours and after that were held in flask containing flower food individually at 25 °C to follow abscission. It was observed that, 20–30% of the floral buds and flowers abscised within 4 days in untreated sample. However, in treated sample, the 1-MCP pretreatment reduced the bud and petal abscission and the cut orchids were still maintained acceptable until day 7 before starting to abscise between 10-14 days of storage period. Result also showed that the ethylene production was inhibited and ACC oxidase activity was decreased in samples treated with 1-MCP. Thus, 1-MCP pretreatments prolong the shelf life of cut orchids from 4 days in control up to 10 days in treated samples, both displayed in 25 °C.*

***Keywords*—ornamental, ACC oxidase activity, ethylene production, quality, shelf life.**

I. INTRODUCTION

The critical criteria of cut flowers are the quality and appearance at the retail and consumer level. Once the flowers are cut from their mother plant, they are gotten to be perishable and sensitive to the environment. They are sensitive to ethylene, agaseous plant hormone that significantly influences their development and growth. A few detrimental consequences of ethylene exposure are premature wilting, flower or petal drop and abnormal opening (Nur Azlin et al., 2013). So, to expand market, the cut orchid needs to have a long vase life, consequently it gets premium price.

In numerous studies to expand the shelf life of ornamental plants, inhibiting the reaction to ethylene is a proficient procedure. Some ethylene inhibitors for example aminoethoxyvinylglycine (AVG), silver ions and aminooxyacetic (AOA) have been assessed for their impacts on ethylene responses. Other than that, the revelation of cyclopropenes, specifically 1-methycyclopropene (1-MCP) is successfully inhibiting ethylene reactions (Sisler, E.C. and Serek, M. 1997, 2003). Application of 1-MCP detailing its advantageous effect against ethylene such as in chrysanthemum and carnation (Hassan and Gerzson, 2002), rosa hybrid (Serek et al., 1994) and many other ornamental species.

Extending the storage life of cut orchids would able them to be distributed in further markets thus gives more prominent opportunity for growers and exporters. Extending the storage life would also result in greater flexibility and efficiency in dealing with cut orchids. Premium Malaysian cut orchid's quality package with long shelf life, all of these will benefit in setting up a premium price thus move forward the economy and develop Malaysian cut flowers industry. Therefore, this study was aimed to evaluate the potential of 1-MCPpretreatment in reducing flower abscission in *Phaleonopsis* cut orchids.

II. MATERIAL AND METHOD

2.1 Plant material

Export grade *Phaleonopsis* cut orchids grown in southern Malaysia were purchased from a commercial farm. The flowers were harvested at commercial maturity stage (50% blooming flowers) and transported on the day of harvest to the Postharvest Laboratory at MARDI, Malaysia. The flowers were sorted for the shape, uniformity of size and defects. Flowers (n=12) were randomized into two treatment groups:1. without 1-MCP or 2. with 1-MCP.

2.2 1-MCP pretreatment

The cut orchids were placed and remained sealed in a plastic chamber at 25°C for 4 h. The amounts of 1-MCP sachet (EthylBloc^{TM}, Floralife, SC, USA) were determined to supply a 10ppm 1-MCP concentration as recommended by manufacturer. Before sealing the chamber lid, 15ml of distilled water was added into the container that contained the

EthylBloc^{TM} sachet. Immediately after addition of water, a proportion of 1-MCP gas was released. Cut orchids that placed in other identical chambers without 1-MCP treatment were set as control.

2.3 Ethylene exposure

After 4 h of 1-MCP treatment, all cut orchids were treated with 1ppm ethylene gas (one injection) for 15 hours at 25 °C. Then, all cut orchids were individually held in 250 ml conical flask containing flower food and displayed in laboratory at ambient temperature of 25 °C.

The bud and flower abscission's rate were observed weekly. When 50% of the flowers had abscised, the shelf life of a cut flower was considered terminated. The ethylene production and capacity to convert ACC to ethylene in vivo were also evaluated during observation.

2.4 Ethylene Production

The ethylene gases produced by cut orchids were measured every 3 days. The method used in this study was similar to method described by Nur Azlin et al.(2013). Following sampling, lids were removed from each container; samples were determined every 2 days for 7 days.

2.5 ACC oxidase Activity

The determination of ACC oxidase activity was based on method described by Fernandez-Maculet and Yang (1992) with modification. Briefly, 8mm in diameter and 10mm in thickness discs were excised from petals. The discs were extracted in 10mM ACC buffer for 30 minutes to measure in vivo ACC oxidase activity. The ethylene gas produced during the incubation was measured using gas chromatography as described by Nur Azlin et al. (2013).

2.6 Statistical Analysis

The results were statistically analyzed using Analysis of Variance (ANOVA). Means separation for each variable was performed using Least Significant Difference (LSD). The means of the main effect are presented in tables (SAS 9.4, Cary, North Carolina).

III. RESULTS AND DISCUSSION

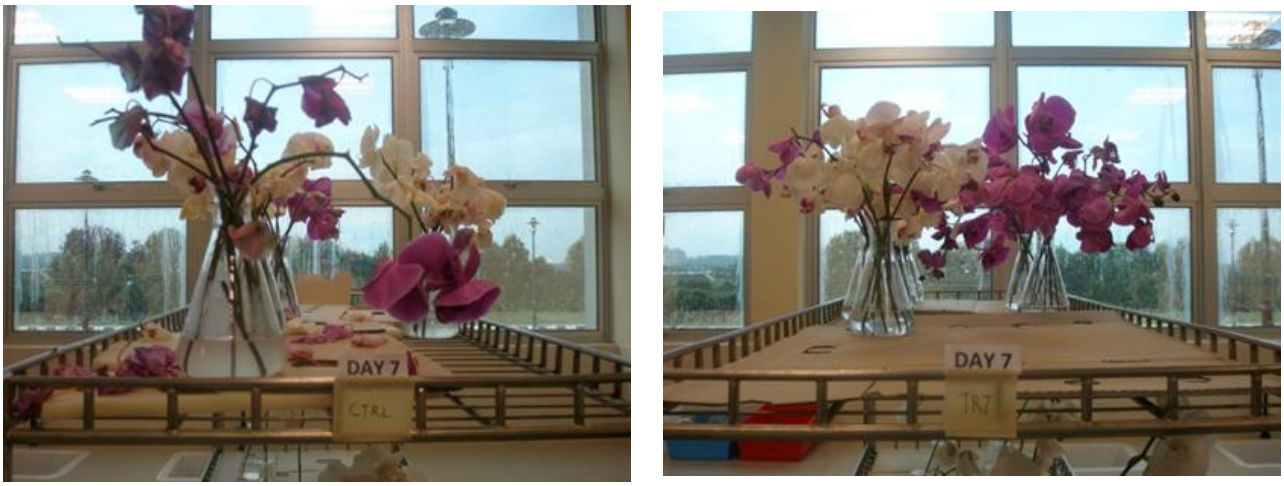
3.1 Rate of flower and bud abscission

Flowers (n=12) from each treatment were evaluated every 4 and 7 days of storage. In white *Phaleonopsis* cut orchids, results showed that buds (20%) and flowers (30%) were abscised within 4 days in control. Fig. 1 showed the flower abscission of white *Phaleonopsis* cut orchids upon arriving, day 4 and day 7 stored in 25 °C. Cut orchids pretreated with 1-MCP maintained fresh with all buds and flowers still intact for 7 days of storage period. The same effect of 1-MCP was also been reported in Pelargonium cut flowers (Cameron and Reid, 2001).This result was also in line with study from Jones et al., 2001, who reported that pretreatment of Geranium inflorescence with the 1-MCP was effective at reducing petal abscission in all the cultivars.

FIG. 1: FLOWER ABSCISSION OF WHITE *PHALEONOPSIS* CUT ORCHIDS UPON ARRIVING, DAY 4 AND DAY 7, ALLDISPLAYED IN 25 °C.

In *purple Phaleonopsis* cut orchids, result showed that bud (30%) and flower (20%) were abscised within 4 days in control as shown by Fig. 2. The abscission rate in control was higher in day 7 and the samples were totally discarded. The 1-MCPtreated samples maintained intactup to day 10 and started to abscise at day 14 with 30% of the buds and 20% of the flower abscised. Bud and flower abscission of white and purple Phaleonopsis cut orchids at day 7 stored in 25 °C were shown in Fig. 3. Thus, pretreatment with 1-MCPcould extend their shelf life from 4 days in control to 10 days in 1-MCP treated samples.

FIG. 2. FLOWER ABSCISSION OF PURPLE PHALEONOPSIS CUT ORCHIDS UPON ARRIVING, DAY 4 AND DAY 7, ALLDISPLAYED IN 25 °C



(A) **(B)**

FIG. 3. BUD AND FLOWER ABSCISSION OF WHITE AND PURPLE *PHALEONOPSIS* CUT ORCHIDS, (A) CONTROL & (B) 1-MCP TREATMENT, BOTH AT DAY 7DISPLAYED IN 25°C

3.2 Ethylene Production

Ethylene production of white *Phaleonopsis* cut orchids treated with 1-MCP was decreased, 0.761µl/kg/hour in control compared to 0.725µl/kg/hour in treated samples. In purple *Phaleonopsis* cut orchids, 1-MCP treatment reduced the ethylene concentration by 0.798µl/kg/hour in control to 0.735µl/kg/hour in treated samples. However, it was no significant difference ($p>0.05$) between control and treated sample in both white and purple *Phaleonopsis* cut orchids for ethylene production (Table 1 and 2).

1-MCP treatment slow down the ACC oxidase activity for both white and purple *Phaleonopsis* cut orchids. The ACC oxidase activity was higher in control sample (15.774µl/kg/hour) and significantly ($p<0.05$) reduced to 10.293µl/kg/hour in treated white *Phaleonopsis* cut orchids. In purple *Phaleonopsis* cut orchids, the ACC oxidase activity in control sample was 17.481µl/kg/hour and reduced to 14.338µl/kg/hour in treated samples. This reduction affected the conversion of ACC to

ethylene and as a result, the ethylene production in treated samples also reduces. This finding was in line with Ketsa et al. (2007) that reported the same result in Dendrobium orchids treated with 1-MCP.

TABLE 1
ACC OXIDASE ACTIVITY AND ETHYLENE PRODUCTION OF WHITE *PHALEONOPSIS* CUT ORCHIDS AFTER PRETREATMENT WITH 1-MCP AND STORAGE AT 25°C.

Treatments	ACC oxidase activity (µl/kg/hour)	Ethylene production (µl/kg/hour)
Without 1-MCP	15.774a	0.761a
With 1-MCP	10.293b	0.725a

Means within a main factor followed by the same letter in the column are not significant (p<0.05).

TABLE 2
ACCO ACTIVITY AND ETHYLENE PRODUCTION OF PURPLE *PHALEONOPSIS* CUT ORCHIDS AFTER PRETREATMENT WITH 1-MCP AND STORAGE AT 25 °C.

Treatments	ACCO activity (µl/kg/hour)	Ethylene production (µl/kg/hour)
Without 1-MCP	17.481a	0.798a
With 1-MCP	14.338b	0.735a

Means within a main factor followed by the same letter in the column are not significant (p<0.05).

IV. CONCLUSION

In conclusion, 1-MCP pretreatment extend the shelf life and reduce the abscission rate of buds and flowers in *Phaleonopsis* orchids. The 1-MCP seems to reduce ethylene production in cut orchids by limiting the ACC to convert to ethylene exhibit by decrease in ACC oxidase activity.

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