Effect of Ethylene Inhibitor on Cut Flower Quality of *Phalaenopsis* Taisuco Light 'H 90-130'

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Summary

Effect of ethylene inhibitors on the flower quality of *Phalaenopsis* Taisuco Light 'H90-130' as STS, AOA, and 1-MCP ethylene inhibitors and stored at 10 ℃, 15 ℃ and at room temperature or 25 ℃. The results showed that STS inhibitors stored at 15 ℃ had increased fresh weight, water absorption rate, and total soluble sugar. STS stored at 15 ℃ showed high rate of total soluble sugar at 5-8 florets. However, 1-MCP stored at 15 ℃ total soluble sugars was high at 1-4 florets and 5-8 florets. AOA stored at 10 ℃ showed increased starch content at 1-4 flowers, 5-8 floret. STS and 1-MCP stored at 10 ℃ showed high respiration rate and ethylene production. Among the three ethylene inhibitors (STS, AOA, and 1-MCP) tested, 1-MCP proved to be the best at 15℃ storage condition. That result showed higher value of total soluble sugar, starch, vase life; however result showed lowest fresh weight loss water absorption, respiration and ethylene production.

Introduction

Ethylene enhances senescence and shortens the vase life of many flowers. The effects of ethylene can be reduced by pre-treating flower with inhibitors of ethylene biosynthesis or action. There are several inhibitors of ethylene biosynthesis, including aminooxyacetic acid (AOA) and aminoethoxyvinyl glycine (AVG) (Yang and Hoffman, 1984). AOA inhibited ethylene production, respiration, prolong longevity of carnation flowers (Fujino *et al*., 1980) and delayed

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senescence in petals of *Hibiscus* (Woodson, 1985). There are treatments inhibitors on the response of flowers to ethylene. Pre-treatments with silver thiosulfate (STS) (Halevy and Kofranek, 1977), an anionic form of silver that was inhibits ethylene action (Veen and Geijn, 1978). Moreover, STS contains silver, an environmental pollutant, and hazard. In recent years the floriculture industry has been seeking an alternative to STS (Serek *et al*., 1995a; Serek *et al*., 1995b). Studies on 1-MCP responses have included commodities such as flowers (Serek *et al*.,1995; Sisler *et al*., 1996a; Sisler *et al*., 1995b). 1-MCP proved an effective inhibitor of ethylene effects in Phlox cut flowers (Porat *et al*.,1995), Alstroemeria (Serek, 1995), Campamula (Sisler, 1999), Cattleya (Yamane *et al*., 2004).

Phalaenopsis (Kataoka *et al*., 2004), Dendrobium (Hew, 1977), Cymbidium (Woltering, 1990), Cattleya (Yamane *et al*., 2004), Aranda (Hew, 1987a), and lily (Susan and Jonathan, 2003) there have differences in their vase life is partly attributed to high sensitivity of ethylene. It increases ethylene production (O'Neill *et al*., 1993). ACC oxidase of Cattleya which is in petals has an important role in shortening vase life (Yamane *et al*., 2004).

The safety, toxicity and environment of 1-MCP are regard extremely favorable to humans, animals, and the environment (Environmental Protection Agency, 2002). 1-Methylcyclopropene (1-MCP) has been developed as a gaseous, non-toxic alternative to STS (Blankenship and Dole, 2003; Serek *et al.*, 1995). Beneficial effects of 1-MCP on many flower species such as Cattleya (Yamane *et al.*, 2004) and Phalaenopsis (Porat *et al*., 1995).

The purpose of this is a study the effect of ethylene inhibitor of 1-Methylcyclopropene (1-MCP), aminooxyacetic acid (AOA), silver thiosulphate (STS) to extending on flower quality of *Phalaenopsis* Taisuco Light 'H90-130' cut flowers orchid of a good quality for market shipment to Japan, European countries. In this research works to prolong shelf life as well as improve our understanding physiological of the Phalaenopsis orchid cut flowers and how to relate ethylene responses.

Material and Methods

Material:

The *Phalaenopsis* Taisuco Light 'H90-130' cut flowers 8-9 flower blooms were bought from the Taiwan Sugar Orchids Company, Tainan, Taiwan. The sample selection of the Phalaenopsis cut flower was based on the variety and uniformity in growth considering vigor, height and stand. After harvesting, the cut flower orchid was immediately tested on the factors prescribed in the experiments following.

Methods:

The experiments were used three type of ethylene inhibitor chemical as (1). 250 nll^{-1}1-MCP (1-Methylcyclopopene) measured according to Sisler (1999), (2). 0.5 mM amino oxyacetic acid (AOA), and (3). 0.5 mM Silver thiosulphate (STS) on *Phalaenopsis* Taisuco Light 'H90-130' cut flowers. AOA and STS was pulse- treated for 6h as described for other flowers. There are kept on storage 10℃, 15℃ and room temperature (25℃).

The different storage conditions are follows: the storage 10℃, 15℃ and room storage (25℃). Each *Phalaenopsis* Taisuco Light 'H90-130' cut flowers did kept in; cool storage 10°C, 15℃ and room storage (25℃) at 10 days after harvested. There were gather data effect of postharvest physiological responds to cut flower quality recording of each treatment with ten replications.

Analysis and measurement

(1) Fresh weights of the samples were collected from individual Phalaenopsis cut flowers. Experiments determined depend on weight number of the day. These are measured as the difference in weight of the vial with the flower at different time of recording of each treatment with ten replications.

(2) Water uptake of the Phalaenopsis cut flower is done by putting them into 25 ml tube and sealed with paraffin. Usually, water is filling continuously daily from the conical flask tube with deionizer water. Water uptake was recorded daily on individual treatment. Water uptake in transpiration rate of Phalaenopsis cut flower was measured at the difference weight of the vial with the flower at different time of recording treatment.

(3) Carbohydrate analysis: Dry ground sample was weighed accurately of 0.1 g and added deionizer water of 10 ml, heated at 30℃ in water bath for 3hrs, left at room temperature for 10 min. Each sample was centrifuged at 2500 rpm for 30 min (Kubota KN-70, Japan). The supernatant was decanted for analyzing total soluble sugar (TSS) and insoluble substance at the bottom of each test tube after centrifugation was taken to analyze starch. There was quantified into a spectrophotometer equipment (Hitachi, UV-2001, Japan) was measured at 490 nm.

(4) Ethylene production and carbon dioxide was measured. An individual a spike Phalaenopsis cut flower enclosed in glass chambers was CO_2 and ethylene. The concentration of ethylene production and CO_2 exiting the glass jar was measured using gas chromatograph (GC-8A, Shimadzu model, Tokyo, Japan) equipment with a thermal conductivity detector (TCD) CO_2 measurement and using of a GC equipped (GC-14B, Shimadzu model, Tokyo, Japan) with a flame ionization detector (FID) ethylene measurement. An ethylene measurement method as described by Saltveit and Yang (1987) was followed.

(5) Vase life: After the Phalaenopsis cut flower was treated ethylene inhibitors, the vase life data were collected. The cut flower bloom was the number of floret at 8-9 florets spike storage at 10℃, 15℃ and room temperature (25℃). The flower spike was observed daily at nine o'clock in the morning until 50% of flower wilted.

Results

The fresh weight of *Phalaenopsis* cut flower showed that, STS stored 15 ℃ the average fresh weight was highest at 18.14% compared to fresh weight loss of AOA and 1-MCP. 1-MCP showed the low fresh weight loss was 10.45 % however it was highest weight loss to AOA treatments 16.86 % at day 9 after harvest respectively. However, the effect of STS on the fresh weight of Phalaenopsis showed a significant incline at 15 ℃ temperature, STS treatment weighed on 5.39%, 9.77%, 14.25% and 15.89% when AOA treated after 10 days at room temperature meanwhile showed intermediate fresh weight values. Thus, the best storage condition in order to maintain commercially acceptable fresh weights for *Phalaenopsis* cut flower is 15 ℃ with 250 nl l^{-1} 1-MCP. (Table 1)

The results of STS treatment were further examined as well as the effects of 25 ℃, 15 ℃ and 10 ℃ under the different storage conditions. The rate of water absorption at 10 ℃ was highest 3.14, 3.45 ml at first and 2 days after harvest (Table 2), while at 25 ℃ showed the high rate 2.36 ml at first day. The STS treatment showed a secondary increase in water absorption starting at day 2 for 10 ℃, but did not at 15 ℃ temperature. The effect of AOA on water absorption in *Phalaenopsis* Taisuco Light 'H90-130' stored at 25 °C, 15 °C and 10 °C showed a general decline in the rate of water absorption (Table 3). But at 10 ℃ a secondary increase was observed on day 2 and day 3 as 2.45, 1.35 ml respectively. However, it is important to note that at 10 ℃, storage of cut flowers showed a sudden decline from day 3 to day 5 but recovered to decreased rate of 1.35, 0.22, 0.21 ml respectively. The rate of water absorption of *Phalaenopsis* cut flower treated 1-MCP and stored at 25 ℃, 15 ℃, or 10 ℃ was determined. Results showed a similar overall decline of water absorption regardless of storage condition. But the initial rate of water absorption was significantly higher stored 10 ℃ and 25 ℃ compared to 15 ℃. The result showed that storage 15 ℃ was a significant decline in the low rate of water absorption on first to day5 respectively (Table 4).

Table 1. Fresh weight loss of cut flower *Phalaenopsis* Taisuco Light 'H90-130' 10 days after treatment of ethylene inhibitor and storage at 15 ℃.

Inhibitor	Fresh weight loss (%) days after harvest				
	1	3	5	7	9
STS[y]	5.39a[z]	9.77a	14.25a	15.89a	18.14a
AOA	5.27b	8.72b	13.23b	14.31b	16.86b
1-MCP	1.98c	2.71c	3.22b	6.23c	10.45c

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS or AOA 0.5 mM for 6 hrs and fumigated 250 nl l^{-1} 1-MCP for 12 hrs each with treated 15 ℃ storage day 10 after harvested.

Table 2. Effect of temperature on the water absorption of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' pulsed 0.5 mM STS for 6 hours.

Storage temperature	Water absorption (ml/stem/day) days in vase				
	1	2	3	4	5
25 °C [y]	2.96b[z]	2.38b	2.16b	1.96a	0.95a
15 °C	2.25c	2.12c	1.91c	1.90a	0.84a
10 °C	3.14a	3.45a	2.55a	1.98a	0.92a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower was pulsed 0.5 mM STS for 6 hrs each storage at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 3. Effect of temperature on the water absorption of cut flower of *Phalaenopsis* Taisuco Light'H90-130' pulsed 0.5 mM AOA for 6 hours.

Storage temperature	Water absorption (ml/stem/day) days in vase				
	1	2	3	4	5
25 °C [y]	2.25a[z]	2.05b	1.08b	0.91b	0.85a
15 °C	2.18b	1.93c	1.16b	1.92a	0.82a
10 °C	2.12b	2.45a	1.35a	0.23c	0.21b

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM AOA for 6 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 4. Effect of temperature on the water absorption of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' 1-MCP fumigated for 12 hours.

Storage temperature	Water absorption (ml/stem/day) days in vase				
	1	2	3	4	5
25 °C	3.12a[z]	2.87a	1.93a	1.92a	1.87a
15 °C	2.62b	2.25b	1.37b	0.96b	0.92b
10 °C	3.22a	2.91a	1.94a	1.98a	1.88a

[z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower treated with 1-MCP for 12 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

The percent total soluble sugar found in 1-4 florets was highest among the floral parts tested for STS influence (Table 5) at 15℃ and 25 ℃ was 8.49% and 7.14%, respectively. There was a decreasing trend in the Total soluble sugar of the floral parts from low (1-4 florets) at 10℃. The effect of STS stored 15℃ was observed to maintain the levels of Total soluble sugar in 5-8 floret parts with averaged 6.97% compared to 5.39% at 10 ℃ and 6.45% at 25 ℃ respectively. The effect of AOA on the total soluble sugar (Table 6) showed an interesting trend when stored at 10 ℃. The amount of Total soluble sugar in 5-8 floral parts was significantly highest which averaged 8.85% compared to 25 ℃ (5.45%), 15 ℃ (6.64%), respectively. The AOA treatment showed that 10℃ storage, the Total soluble sugar was maintained at higher levels in 1-4 florets and 5-8 floret parts compared to room temperature and 15 ℃.

1-MCP storage 15 ℃ showed the highest average Total soluble sugar at 9.64%, followed by 9.25% at 25 ℃ and 6.56% at 10 ℃ (Table 7). It was interesting to note that the 1^{st}-4^{th} florets and5^{th}-8^{th} florets position displayed a higher percent Total soluble sugar at 15℃ and 25 ℃. 1-MCP can be used to effectively promote higher Total soluble sugar rates. AOA treatment was effective when cut flowers are stored at 10 ℃. For STS treatment and subsequent storage at 15 ℃ was most significant in maintaining Total soluble sugar levels in all floral parts.

The effect of STS on the starch content of *Phalaenopsis* Taisuco Light 'H90-130' was analyzed at 15 ℃, 1^{st} – 4^{th} florets showed the highest starch content with 9.89% and was observed from the 5^{th} – 8^{th} florets (8.81%). On the other hand, at 10 ℃ very low starch content was recorded 4.42% for 1^{st}–4^{th} florets and 3.56% with5^{th} to 8^{th} florets respectively the average starch content in this specific storage condition (Table 8).

Table 5. Effect of temperature on total soluble sugar of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' pulsed STS for 6 hours.

Temperature	Total Soluble Sugar (%DW) of flower organ	
	1st to 4th florets	5th to 8th florets
25 °C	7.14a[z]	6.45a
15 °C	8.49a	6.97a
10 °C	5.35b	5.39c

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS for 6 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 6. Effect of temperature on total soluble sugar of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' pulsed AOA for 6 hours.

Temperature	Total Soluble Sugar (%DW) of flower organ	
	1st to 4th florets	5th to 8th florets
25 °C	5.31c[z]	5.45c
15 °C	6.15b	6.64b
10 °C	8.37a	8.85a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM AOA for 6 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 7. Effect of temperature on total soluble sugar of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' 1-MCP fumigated for 12 hours.

Storage temperature	Total soluble sugar (%DW) of flower organ	
	1st to 4th florets	5th to 8th florets
25 °C	9.25a[z]	9.16a
15 °C	9.64a	9.58a
10 °C	6.56b	7.19b

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower treated 1-MCP for 12 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 8. Effect of temperature on starch of cut flower of *Phalaenopsis* Taisuco Light'H90-130' pulsed STS for 6 hours.

Storage temperature	Starch (%DW) of flower organ	
	1st to 4th florets	5th to 8th florets
25 °C	8.41b[z]	7.33b
15 °C	9.89a	8.81a
10 °C	4.42c	3.56c

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS for 6 hrs at 25 ℃, 15 ℃ and 10 °C with day 10 after harvested.

Effect of AOA treatment on the starch content of 1st - 4th florets stored at10 ℃ (Table 9) showed significantly high values9.21% compared to 25 ℃ and 15 ℃ with 4.61% and 7.16%, respectively. Florets at the 5th - 8th position at 10 ℃ showed higher starch content (9.54 %) compared to storage 15 ℃ and 25 ℃ respectively.

Treatment with 1-MCP showed a decreasing trend in terms of floral position and storage condition (Table 10.). Such that, 1-4 florets and 15 ℃ recorded the highest starch content with 8.39% while, conversely, at room temperature and 10 ℃ showed the lowest at 7.53% and 5.86% respectively. The average values of starch contents shown in a descending manner at 15 ℃ for 8.18%, 10 ℃ for 5.28% and at room temperature for 6.81%.

Table 9. Effect of temperature on starch of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' pulsed AOA for 6 hours.

Storage temperature	Stach (%DW) of flower organ	
	1st to 4th florets	5th to 8th florets
25 °C	4.61c[z]	5.18c
15 °C	7.16b	6.56b
10 °C	9.21a	9.54a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM AOA for 6 hrs at 25 ℃, 15 ℃ and 10 °C with day 10 after harvested.

Table 10. Effect of temperature on starch of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' 1-MCP fumigated for 12 hours.

Storage temperature	Starch (%DW) of flower organ	
	1^{st} to 4^{th} florets	5^{th} to 8^{th} florets
25 °C	7.53b[z]	6.81b
15 °C	8.39a	8.18a
10 °C	5.86c	5.28c

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower treated 1-MCP for 12 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

The results were affected of ethylene inhibitors upon the addition of ethylene on the respiration rate of Phalaenopsis cut flowers. Some of the treatments within of 1 nl l^{-1} C_2H_4 for 1-MCP ranging storage periods of 6, 12 and 18h initial respiration rates (day1) were significantly highest with values ranging from 1.96-4.99 CO_2 ml/kg.h.(Table 11.) Interestingly, treatment of 1-MCP 6h+ C_2H_4 showed a higher respiration rate of 4.99 CO_2 ml/kg.h. 1-MCP 12 hrs+ C_2H_4 showed enough prevented exogenous ethylene. Whatever, STS treatment at the first 2^{nd}, 3^{rd}, 4^{th} and 5^{th} days after harvest, a highest rate of respiration with values of 4.24, 2.83, 2.82, 2.47 and 6.36 CO_2 ml/kg.h, respectively.

STS treatment at 10 ℃ (Table 12) showed the highest level of respiration rate, with a peak at day 3 and 5 with 5.25 and 6.35 CO_2 ml/kg.h. There was a general increase in respiration rate in all storage conditions at 5days. AOA treatment showed a similar trend of increased respiration rate at day 5 regardless of storage condition. But from first day to 3 days the respiration rate at 25 ℃ was significantly high at 3.67, 3.98 and 3.87 CO_2 ml/kg.h. respectively (Table 13.). AOA treatment at 15℃ showed lowest level was respiration rate.

1-MCP treatment at 10 ℃ (Table 14) showed the highest of respiration rate, with a peak at 1st day was 2.43 CO_2 ml/kg.h. and high respiration rate 2-5days. At day 5, there was a general increase in respiration rate in all storage conditions. 1-MCP treatment 15 ℃ showed a lower respiration rate was 1.60, 1.39, 1.11, 1.19 and 2.01 CO_2 ml/kg.h day2, 3, 4 and day5 of storage condition respectively.

Treatment with 1-MCP stored for 6, 12 or 18h showed a significant inhibition of C_2H_4 production (0.02 and 0.06 2 C_2H_4 nl l^{-1}) at day 1. The addition of 1 nll^{-1} C_2H_4 exhibited a higher rate of C_2H_4 production. However, 1-MCP 12 h+ C_2H_4 and 1-MCP 18h + C_2H_4 at day first, second, 3 days was prevented exogenous ethylene lowest in C_2H_4 production rate rang at 0.10 to.0.13 C_2H_4 nl l^{-1}.

Table 11. Respiration rate of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' after kept at room temperature 25 ℃ and difference ethylene inhibitors within ethylene.

Treatment	Respiration rate (CO_2 ml/kg.h) days after harvest				
	1	2	3	4	5
STS	4.24a[z]	2.83a	2.82a	2.47a	6.36a
AOA	3.12b	2.49b	1.87b	1.86b	4.98b
1-MCP 6 h	2.39c	1.52d	1.52c	1.31c	3.04c
1-MCP 12h	2.17d	1.31e	1.08e	1.07d	2.61d
1-MCP 18h	1.96e	1.30e	1.31d	1.09d	1.35e
1-MCP 6h + C_2H_4	4.99a	1.74c	1.73b	1.11d	1.52e
1-MCP 12h + C_2H_4	2.38c	1.53d	1.52c	2.39a	1.34e
1-MCP 18h + C_2H_4	2.18d	1.31e	1.33d	1.32c	1.32e

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS or 0.5 mM AOA for 6 hrs and 250 nll^{-1} 1-MCP for 6, 12, 18 hrs and within $C_2H_4$1nll^{-1}.

Table 12. Respiration rates of cut flower of Taisuco Light 'H90-130' after STS pulsing for 6 hours and kept at different temperatures.

Storage temperature	Respiration rate (CO_2 ml/kg.h) days after harvest				
	1	2	3	4	5
25 °C	2.83b[z]	3.18a	2.12b	2.47a	4.95b
15 °C	2.24c	1.83c	1.62c	2.03b	3.25c
10 °C	3.28a	2.63b	5.25a	2.18b	6.35a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS for 6 hrs at 25 ℃, 15 ℃ and 10 °C with day 10 after harvested.

Table 13. Respiration rates of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' after AOA for 6 hours and kept at different temperatures.

Storage temperature	Respiration rate (CO_2 ml/kg.h) days after harvest				
	1	2	3	4	5
25 °C	3.67a[z]	3.98a	3.87a	2.49a	5.61a
15 °C	2.46b	2.91b	2.90b	2.45a	3.35b
10 °C	2.58b	2.84b	2.58b	2.13b	2.86c

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM AOA for 6 hrs at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Table 14. Respiration rates of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' after 1-MCP fumigates at different temperatures.

Storage temperature	Respiration rate (CO_2 ml/kg.h) days after harvest				
	1	2	3	4	5
25 °C	1.73b[z]	1.53b	1.30b	1.52b	2.39b
15 °C	1.60c	1.39c	1.11c	1.19c	2.01c
10 °C	2.43a	2.21a	1.77a	1.99a	3.11a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower treated 1-MCP for 12 hrs at 25℃, 15℃ and 10℃ with day 10 after harvested.

Table 15. Ethylene production of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' after ethylene inhibitors and kept at 25 ℃ temperatures.

Treatment	Ethylene production (nl/g.h) days after harvest				
	1	2	3	4	5
STS	0.14b[z]	0.14b	0.10d	0.43c	0.07e
AOA	0.05d	0.06d	0.18b	0.46c	0.25a
1-MCP 6 h	0.06d	0.14b	0.14c	0.46c	0.21b
1-MCP 12h	0.02e	0.11c	0.07e	0.37d	0.19c
1-MCP 18h	0.02e	0.10c	0.06e	0.31d	0.14d
1-MCP 6h + C_2H_4	0.36a	0.62a	0.56a	0.75a	0.05f
1-MCP 12h + C_2H_4	0.12c	0.11c	0. 13c	0.64b	0.04f
1-MCP 18h + C_2H_4	0.11c	0.10c	0. 11d	0.32d	0.21b

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower pulsed 0.5 mM STS or 0.5 mM AOA for 6 hrs and 250 nll^{-1} 1-MCP for 6, 12, 18 hrs and within $C_2H_4 1nll^{-1}$.

The vase life of Phalaenopsis stored at 15℃ day10 determined by ethylene inhibitor of STS, AOA, 1-MCP 12h treatment stored. Table 16 showed that 1-MCP 12h significantly extended vase life rate at the day 12.56 to comparative. STS and AOA decrease value ranging of 8.24 to 10.19 days. Storage at 10 ℃ showed that 1-MCP 12h shorten vase life rate at the day 5.84 and 5.61 to 5.75 days with STS and AOA decrease value of vase life. Storage at 25 ℃ showed that AOA significantly extended vase life rate at the day 6.64 to comparative. STS and 1-MCP 12h decrease value ranging of 6.21 to 6.55 days respectively.

Table 16. Vase life of cut flower of *Phalaenopsis* Taisuco Light 'H90-130' at 10 ℃, 15 ℃ and 25 ℃ stored and different ethylene inhibitors.

Treatment	Vase life (Days)		
	10 ℃	15 ℃	25 ℃
STS	5.61a[z]	8.24c[z]	6.21b[z]
AOA	5.75a	10.19b	6.64a
1-MCP	5.84a	12.56a	6.55a

[Z] Mean separation with columns by Duncan's multiple range test at P≤0.05.

[Y] Flower was treated 1-MCP fumigated for 12 hrs each storage at 25 ℃, 15 ℃ and 10 ℃ with day 10 after harvested.

Discussion

Effects of 1-MCP 12h at15 ℃ more effective fresh weight *Phalaenopsis* Taisuco Light 'H90-130' cut flower was high rate of fresh weight. Both of STS and AOA was high fresh weight same as 1-MCP treatment. 1-MCP 250 nll^{-1} at 15℃ storage was lower water absorption. Water absorption rate of STS with 15 ℃ storage showed lower absorption rate same as 1-MCP 15 ℃ storage of cut flower. Other handle AOA was lower water absorption rate by treated with 10 ℃ storage. Effect of 1-MCP with 15 ℃ was highest percent of TSS as 1-4 florets 5-8 florets. STS with 15 ℃ storage showed high percent rate TSS. In the cash of AOA more effective storage condition with10 ℃ storage showed 1-4 florets and 5-8 florets position. Effect of 1-MCP on starch of *Phalaenopsis* cut flower was high percent starch with 15℃ storage. Storage condition of 10 ℃ with AOA was effective than 15 ℃ storage and room storage. STS with 15 ℃ storage showed high rate starch at 1-4 floret and flower stem. Respiration rate of *Phalaenopsis* cut flower on 1-MCP 15 ℃ was low rate of respiration. 1-MCP10℃ storage was more effective high respiration rate than 15 ℃ storage and 25 ℃ room temperature. In

Phalaenopsis Taisuco Light ‘H90-130’ cut flower 1-MCP has been reduced respiration rate and according noted Alstroemeria spp (Serek *et al*., 1995). Applications of 1-MCP 250 nll^{-1} 12 to 18 h at 15 ℃ was effective cut flower prevent ethylene production. Storage condition low temperature has been used effective relationships exist between time and temperature. 1-MCP applications at low temperatures are not effective on some crops. Application low concentration of 1-MCP 5 or 25 nll^{-1} with low temperature at 2 ℃ was not effective *Penstemon* ‘Firebird’. However, application at 20 ℃ of *Alstroemeria* spp., *Antirrhinum* majus result a complete protected exogenous ethylene (Serek *et al*., 1995a). *Phalaenopsis* ‘Herbert Hager’ 250 nll^{-1} at 22℃ 6 h was prevented the pollination induced in ethylene production and the enhanced senescence the flower (Porat *et al*., 1995). *Phalaenopsis* Taisuco Light ‘H90-130’ cut flower orchid position 1-4 floret has been effective starch and Total soluble sugar. When applying 1-MCP plant development stage must be considered effects vary with plant maturities. Carnation flower (single flower), Delphinium, Gypsophiliapaniculata (spike flower) may be completely protected from ethylene (sisler *et al*., 1996). TSS was higher in 1-MCP treated *Phalaenopsis* Taisuco Light ‘H90-130’ cut flower.

Studies treatment duration ranged from 12 to 18 h has been sufficient to achieve a full response prevented exogenous ethylene *Phalaenopsis* Taisuco Light ‘H90-130’ flower. An exposure of 1-MCP 250 nl l^{-1} 6 h+C_2H_4 1 nl l^{-1}, STS 0.5mM+C_2H_4 1 nl $l^{-1}$was used not enough to induce respiratory or ethylene production. A time and temperature relationship was noted with Lupinushavardii ‘Texas Sapphire’ 1-MCP 450 nl l^{-1} temperature 15℃ 12 h was reduce fresh weight loss and reduced flower abscission (Picchioni *et al*., 2002). Lilium ‘Mona Lisa’ and ‘Stargazer’ 1-MCP 500 nl l^{-1} 25℃ 18h prevented effects of exogenous ethylene (Celikel *et al*., 1001). 1-MCP will protect plant products from both endogenous and exogenous source of ethylene (Sisler *et al.,* 1999). Gypsophila flowers open was delayed by 1-MCP and STS but delayed senescence of floral buds not opened treatment (Newman *et al*., 1998).

1-MCP 250 nl l^{-1} 12 h prevented exogenous ethylene induces increase in electrical conductivity in *Phalaenopsis* Taisuco Light ‘H90-130’ cut flower. 1-MCP prevented exogenous induce ethylene increase in electrolyte leakage, decrease membrane protein and decrease lipid fluidity in petunia flower (Serek *et al.,* 1995 d).

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乙烯抑制劑對蝴蝶蘭雜交品種切花品質之影響

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關鍵字：蝴蝶蘭、乙烯抑制劑、切花、品質

摘要： 本研究在探討乙烯抑制劑對蝴蝶蘭雜交品種 (*Phalaenopsis* Taisuco Light 'H 90-130')切花品質之影響。在三種乙烯抑制劑(STS, AOA 和 1-MCP)之間，其結果指出，使用 STS 乙烯抑制劑儲藏在 15 ℃ 下會增加鮮重、吸水率以及全可溶性糖且 5-8 朵花的全可溶性糖較高，而 1-MCP 儲藏在 15℃ 下全可溶性糖在 1-4 朵及 5-8 朵花較高。AOA 儲藏在 10℃ 下其 1-4 朵及 5-8 朵花的澱粉量增加。使用 STS 以及 1-MCP 儲藏在 10 ℃ 下有較高的呼吸率以及乙烯生成率。本實驗所使用的三種乙烯抑制劑之效果，以 1-MCP 於 15 ℃ 之下處理的效果最佳，表現出最高的總可溶性糖、澱粉、瓶插壽命值。

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