Agricultural Sci. J. 42 : 3 (Suppl.) : 351-354 (2011) ว. วิทย. กษ. 42 : 3 (พิเศษ) : 351-354 (2554)

Effects of 1-MCP and storage temperature on vase life of cut *Mokara* inflorescences

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Abstract

The effects of 1-MCP and storage temperatures on the vase life and other physiological characteristics of cut *Mokara* inflorescences were studied. The experiment was designed as a 4x2 factorial in CRD. The first factor was four levels of 1-MCP (0, 1, 2 and 4 sachets of EthylBloc with 2.5 gm per sachet containing 0.014% 1-MCP) and the second factor was 2 levels of storage temperature (27 and15°C). After harvest, the inflorescences were sorted out for uniformity before being used in the experiment. Methods and dosage for application of EthylBloc (1-MCP) were as lower than (1 sachet), equal to (2 sachets) and higher than (4 sachets) the company's recommendation (2 sachets per box up to the volume of 3 ft^3). The inflorescences were packed along with the EthylBloc sachets in the 0.34 ft^3 cardboard boxes which were kept for 3 days at two different temperatures for simulated shipment. After unpacking, vase life, rate of respiration, ethylene production, water uptake, water balance and total sugars content were monitored. The results showed that the inflorescences treated and stored at 15°C had a longer vase life of 12.0 days while at 27°C the vase life was 10.2 days. Storage at lower temperature resulted in a lower rate of respiration. There was no significant effect of different levels of 1-MCP on *Mokara* vase life and other physiological characteristics. Additionally, there was no interaction between 1-MCP level and storage temperature on these parameters.

Keywords: *Mokara*, 1-MCP, vase life, storage temperature

Introduction

Vase life is a yardstick for the longevity of cut flowers and is an important target for improving flower characteristics by chemical treatments. Like any other cut flower, orchids face vase life-related problems such as excessive water loss, decline in respirable substrates and sensitivity to exogenous or endogenous ethylene that hastens senescence and wilting of the flowers (Hew, 1994). Therefore, it is essential to inhibit the action of ethylene by various means and to prolong the vase life of flowers.

Recently, a non-toxic ethylene action inhibitor, the compound 1-methylcyclopropene (1-MCP) has been reported to prolong the display life of several horticultural commodities (Honghem *et al*., 2007) by acting as a competitor with ethylene for the binding site on ethylene receptor. The EthylBloc sachet containing 2.5 gm powder per sachet is a convenient application method that can extend the life and usefulness of many fresh cut flowers and potted flowers including orchids.

The genus *Mokara*, a multigeneric vandaceous hybrid is a result of crosses among three genera (*Arachnis* x *Ascocentrum* x *Vanda*) (Yew-Hwa, 1995) and are one of the most popular cut flowers in the international trade. At present, there is still a need for more information of 1-MCP applications on the postharvest of *Mokara* orchids. Therefore, this study aimed to find out the effect of 1-MCP on vase life and other physiological characteristics of cut *Mokara* inflorescences treated at two temperature levels.

Materials and Methods

Cut inflorescences of *Mokara* 'Sayan Dongporn' were packed in 0.34 ft^3 cardboard boxes with 0, 1, 2 and 4 sachets of EthylBloc misted with water and the boxes were kept at room temperature (27°C) and low temperature (15°C) for 3 days for simulated shipment. After unpacking, the inflorescences were kept in glass bottles containing distilled water at room temperature (27±2°C) and observations were made on vase life,

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respiration, ethylene production, water uptake, water balance and total sugars content in florets and stems. The vase life was terminated when 50% wilting and drooping of the florets was observed. The experiment was arranged as a 4x2 factorial in completely randomized design. Data were analyzed statistically by using analysis of variance and mean comparisons were assessed by Duncan's multiple range test (DMRT).

Results

The results from this experiment showed that the vase life of *Mokara* inflorescences was highly significant at two different temperatures (11.95 days at 15°C and 10.20 days at 27°C) (Figure 1A). A significantly higher rate of respiration was observed at 27°C (165.99 mgCO_2/kg/hr) on days 2 and 6 (151.89 mgCO_2/kg/hr) after unpacking (Figure 2A) whereas no significant difference was found in ethylene production in the inflorescences treated at two temperatures (Figure 2B). Moreover, respiration and ethylene production increased on day 8 after unpacking at 15 and 27°C. Inflorescences treated at 15°C showed a significantly higher amount of water uptake (46.20 µl/gm FW/day) and maintained more water balance (7.53 µl/gmFW/day) on day 1 after unpacking which gradually decreased thereafter (Figures 3A, 3B). Furthermore, the total sugars content in the florets (on days 0 and 4) and in stems (on days 0, 4, 6 and 8) at 15°C were significantly higher than at 27°C after unpacking (Figures 4A, 4B). The highest total sugars content in the florets (2.83 mg/gmFW) and stems (1.72 mg/gmFW) was observed on day 0 after unpacking. However, the exposure to different sachets of 1-MCP and the combination of 1-MCP sachets and temperature had no significant effect on the vase life (Figure 1B), respiration, ethylene production, water uptake, water balance and total sugars content.

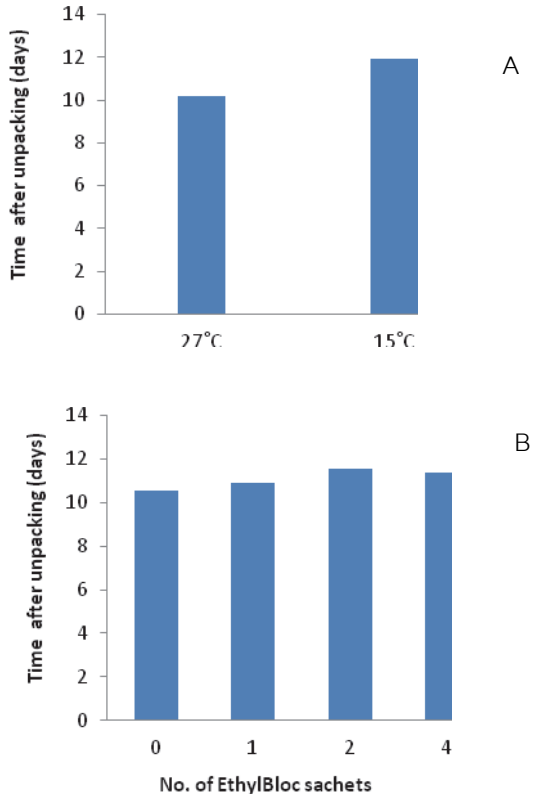


Figure 1 Vase life of cut *Mokara* inflorescences as influenced by storage temperature (A) and the presence of EthylBloc (B).

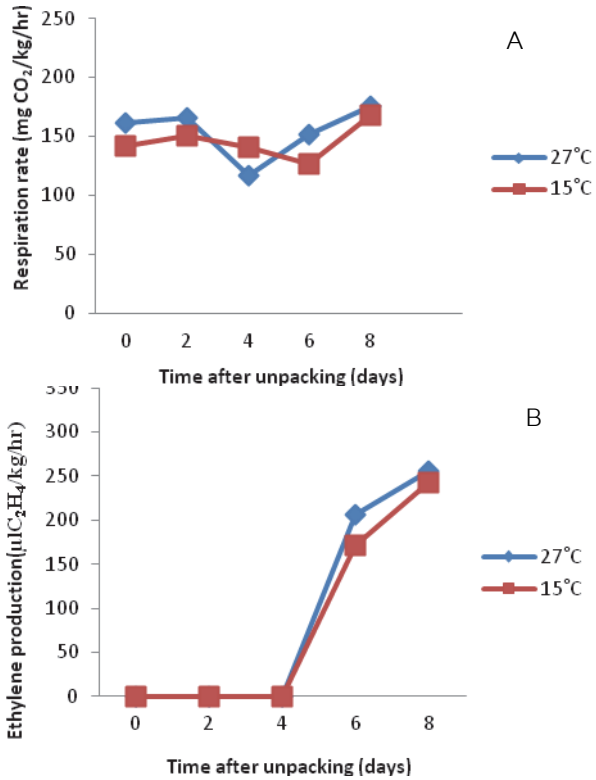
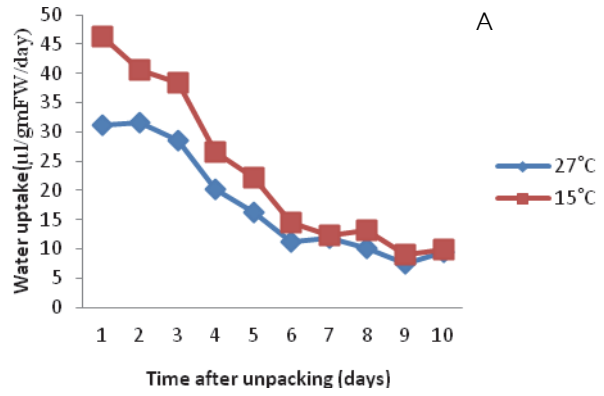


Figure 2 Rate of respiration (A) and ethylene production (B) of cut *Mokara* inflorescences as influenced by storage temperature.



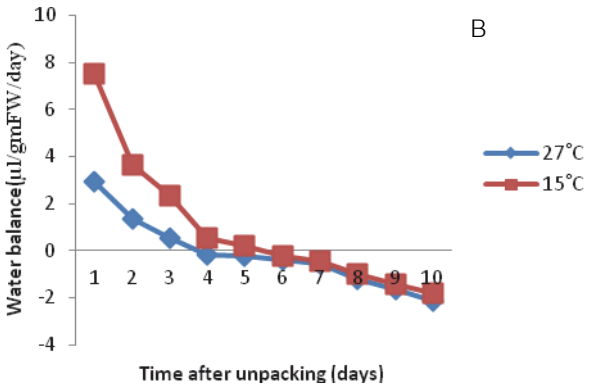
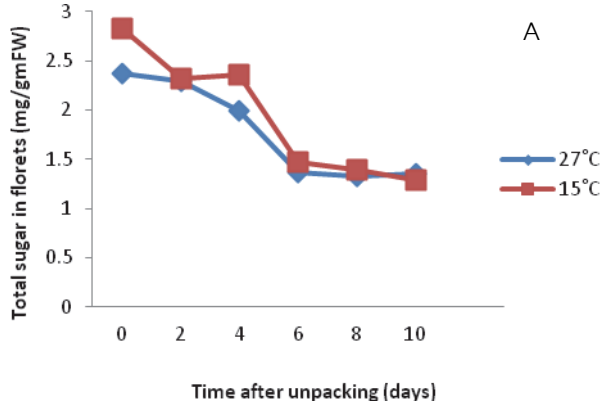


Figure 3 Water uptake (A) and water balance (B) of cut *Mokara* inflorescences as influenced by storage temperature.



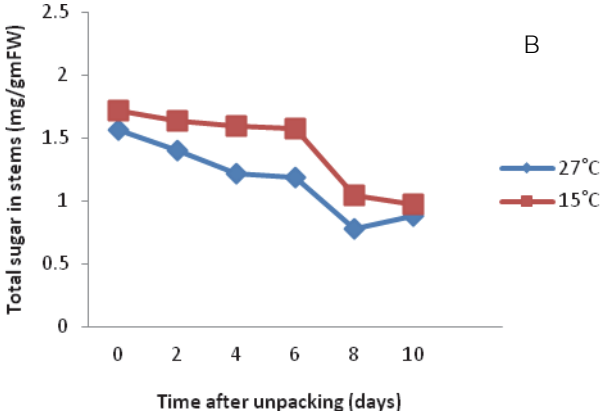


Figure 4 Sugar content in florets (A) and stems (B) of cut *Mokara* inflorescences as influenced by storage temperature.

Discussion

The longer vase life of cut *Mokara* inflorescences at 15°C as compared to shorter vase life at 27°C, could be due to a greater respiration rate at higher temperature as shown by our results. This is in agreement with the findings of Tshwenyane and Bishop (2009) who reported an increase in respiration rate of cut rose flowers with an increase in storage temperature. High temperature causing high respiration in flowers has deleterious effects as shown by the short vase life of flowers stored at room temperature. The increase in respiration and ethylene production on day 8 after unpacking may be due to the disease as the rotting symptom was observed on the stem. Malathrakis and Goumas (1999) reported that higher levels of ethylene are considered to be an early response of plants to pathogen attack. The greater water uptake in the initial days and then decrease in uptake at the start of senescence is similar to the results obtained for Sonia cut rose, where the water uptake and loss increased during initial days after harvest (Ichimura *et al*., 1999). A decline in water uptake seems to be a general phenomenon in many aging cut flowers (Mayak *et al*., 1974).

Moreover, the lower sugar content at 27°C seems possible as higher rate of respiration was observed at this temperature. In both florets and stems, sugar content slowly decreased as time in storage increased probably due to the utilization of sugars as a respiratory substrate. The total sugars content in the florets was higher than that in stems throughout the experiment suggesting that the decrease in sugar content in stems is due to the export to florets as in the case of roses (Marission and Brijn, 1995). However, the range of 1-MCP dosages and its combination with temperature seemed to be ineffective in extending the vase life of *Mokara*. This result seems logical as there was no significant difference in respiration, ethylene production, water uptake, water balance and

total sugars content in florets and stems treated with different 1-MCP concentrations and stored at two temperature levels.

The lack of a response to 1-MCP may be due to the fact that plant tissues vary greatly in their ability to respond to the 1-MCP substance regarding the species and cultivars, growing conditions and maturity (Blankenship and Dole, 2003). Additionally, it may be due to the transient ability of 1-MCP to bind to ethylene receptors of the plant tissue in which their effects for blocking the ethylene produced at the later storage is not permanently attached, or it binds to the other receptors (Sisler and Serek, 1997). The future availability of binding sites after treatment varies among crops. Some crops such as flowers and tomatoes can regenerate sites fairly quickly making 1-MCP treatment ineffective (Blankenship and Dole, 2003).

Conclusion

In conclusion, the present study revealed that simulated shipping at lower temperature (15^{o}C) was effective in extending the vase life of cut *Mokara* inflorescences whereas different levels of 1-MCP and the combination of 1-MCP and temperature were ineffective in improving the vase life. Therefore, it is suggested that further studies need to be conducted to find out the effects of 1-MCP and temperature at different levels.

Acknowledgement

This research work was financially supported by Thailand International Development Cooperation Agency (TICA).

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