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Effect of sucrose and kinetin on the quality and vase life of *Bougainvillea glabra* var. Elizabeth Angus bracts at different temperatures

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Abstract

A study was conducted to investigate the effects of sucrose and kinetin on the post harvest quality and vase life of Bougainvillea bracts at different storage temperatures. Bougainvillea bracts and flower (*Bougainvillea glabra*) at the same age and size were used in the experiments. Fresh bracts were continuously treated with 200 mg/l sucrose, 200 mg/l kinetin and control (water) at 10°C, 20ºC and 28±1ºC. It was observed that sucrose treated bracts exhibited the longest vase life compared to the control and kinetin treatments at different temperatures. The higher temperature has promoted water uptake, senescence and abscission. All the treatments showed a shorter vase life at a higher temperature. Kinetin treated flowers exhibited a shorter vase life than the control at all the temperatures. The vase life was the longest in sucrose at a low temperature (10ºC). Weight loss and water uptake initially increased up to the 3rd day of storage, irrespective of the different treatments, but subsequently decreased linearly. The results showed that sucrose and lower temperature were the most effective factors in extending the vase life, as well as the quality of bougainvillea bracts.

Keywords: Sucrose, kinetin, temperature, quality, vaselife, Bougainvillea

Introduction

Genus Bougainvillea contains eighteen species, native tropical to subtropical regions of South America from western Brazil to to southern Peru and Argentina. Bougainvilleas are popular ornamental plants in most areas with warm climates, including Australia, the Caribbean, India, Malaya, the Mediterranean region, South Africa, Taiwan and the United states in Arizona, California, Florida, Hawaii and southern Texas Chittenden. The *Bougainvillea glabra* L. belongs to Nyctaginaceae family, is commonly known as paper flower, owing to their thin papery bracts (Saifuddin *et al.,* 2010; Saifuddin *et al.,* 2009a). The actual flower of the plant is small and generally white, but each cluster of three flowers is surrounded by three or six bracts with the bright colors associated with the plant, including pink, magenta, purple, red, orange, white and yellow. They are thorny woody, vines growing anywhere, about 1-12 meters tall, scrambling over other plants with their hooked thorns. The bougainvilleas brilliants color displays are enjoyed Florida to California, from the south French to Southeast Asia to Australia and through out the tropical America. Bougainvillea plant is used to decorate fences and arbors with explosions of color in the house corridor, office and play ground. Bougainvillea is also used to create beautiful flowering bonsai specimens. Bougainvillea flower are dropped having a short vase life (Chang and Chen, 2002). It has been reported that bougainvillea bracteoles were attractive at the end of 6-day observation period and dropped 32.2% treated with STS (0.5 oz/Gallon) while, 100% was dropped in control tree. Bougainvilleas are commercially viable because of their brilliants color (Saifuddin *et al.,* 2009b). Malaysia is a relatively new consumer in the world in cut flower industry. Bougainvilleas can be used as cut flower as a locally. Bougainvilleas bracts wilt and floral axis becomes bent just within a few days due to causing by vascular occlusion, which inhibits water supply to the flowers (Hossain *et al.,* 2007). Senescence in many plants is accelerated by ethylene. The reduction in vase life after cutting was characterized by advanced wilting of leaves and color fading of petals. Longevity of vase life was an important factor in consumer preference and considerable research has been carried out on the causes of carnation senescence (Hye and William, 2009). Senescence of cut flowers was induced by several factors, e.g., carbon availability (Ichimura *et al.,* 2000), carbohydrate depletion, water stress (Sankat and Mujaffar, 1994), micro-organisms (Witte and Van Doom, 1991) and ethylene effects (Wu *et al.,* 1991). Van Doorn *et al.* (1991) observation by electron microscopy and suggested that vascular occlusion can indeed be caused by bacteria, leading to shortening of the vase life of cut flowers. Carbon availability is a controlling factor to extend a vase life of cut flower. Chang and Chen (2002) recommended that STS and NAA hormone can be apply to improve post harvest life of bougainvillea flowers. Another factor for cut flower is storage temperature. Increasing storage temperature from 1 to 10 ºC resulted in a progressive shortening of subsequent vase life (Pompodakis *et al.,* 2005). Some other researchers supported that the vase life of cut flower at high temperature might be decreased dramatically due to early development of bent necks and leaf desiccation (Uda *et al.,* 1995; Ichimura and Ueyama, 1998). Bracts of Bougainvillea can be used as cut flower and

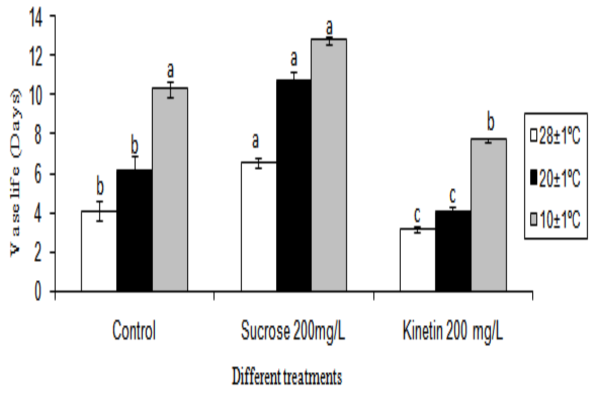

Fig. 1. Vase life for *Bougainvillea glabra bracts* as affected by different storage conditions

literatures are not yet available on this research project. That is why our interest has grown to develop the vase life of bougainvillea flower. The aims of this study is to determine a suitable holding solution to develop quality and prolong the vase life of *Bougainvillea glabra* var. Elizabeth Angus bracts in storage condition.

Materials and methods

Site

The experimental site was University of Malaya campus, Kuala Lumpur, Malaysia.

Plant Material

Two-year-old Bougainvillea trees were used in this experiment for collecting flower samples. Bougainvillea bracts with flower (purple) were collected from nursery, University of Malaya campus, Kuala Lumpur, Malaysia. The plant was 0.2 m of height and canopy length was 1.0 m. The plant consisted of 7 branches. Bracts were harvested from each branch randomly. Weeding, irrigation and pesticide were done as needed.

Flower Harvesting and Measurement

Bracts with flower were harvested on 20 July, 2008. Bracts were weighed initially immediately after harvest and used for setting treatments.

Treatment Setting

Treatments were set following Randomized completely blocked design. Each treatment was repeated by 3 replications. Total 27 flowers with bracts were collected for 3 treatments at different temperature. In storage condition, bougainvillea flower with bracts were placed in distilled water (control) and solution containing 200ppm sucrose, 200ppm kinetin at 10°C, 20°C, and 28±°C for experiments

Vase life

The vase life was calculated by counting number of days that bracts are remained acceptable for users. Bract status was observed every day.

Water uptake and weight loss measurement

The difference between consecutive weighting of the vials plus solution (without the flower) was used to determine the water uptake. Evaporative water loss was deemed negligible. Weight loss (%) of flower with bract was calculated by using the following formula: Weight loss (%) = W_0-W_N/W_0×100
Where W_0= Weight of flower for day 0
W_N= Weight of Flower for day 4 or 8

Bract discoloration (Color Changed) and Senescence Evaluation

Percent bract discoloration was calculated by observing the total bract area divided by discolored bract area multiplying by100. Senescence starting was indicated by initial browning of the bracts and the bracts were considered dead. Bract senescence was evaluated by observing bract senescence symptom.

Bract drop (abscission) measurement

Bracts containing flowers were forced with air using fan. The flowers were kept in front of the table fan for 5 min. The petal was dropped by air force and petal drop percent was calculated.

Design of Experiment

The experimental was in Completely Randomized Designed (CRD). There were 3 replications and a total of 27 flowers were used in the experiment. Standard Error (SE) was calculated.

Results

Vase life

In this study, the vase life of bougainvillea bracts was significantly affected by their treatments and temperature. It was recorded that sucrose treated flowers exhibited the longest vase life compared to the control and kinetin treatments at different temperature (Fig.1). The longest vase life (12.8 days) was recorded in bracts with flowers containing sucrose (200ppm) solution, followed by control (10.3 days) at 10°C. Kinetin treated bracts exhibited a short vase life (3.1 days) at 28±1ºC compared to other treatment. All the treatments showed a shorter vase life at a higher temperature.

Water uptake at different temperature

It was found that the Bougainvillea bracts held in 200 mg/L sucrose showed the highest amount of water uptake which recorded approximately 0.04 g for day 2 and 0.02 g for day 5 at 28±1ºC. Kinetin 200 mg/L showed the lowest water uptake value (0.016 g) at 2nd day and 0.007 g for 4th day (Fig. 2).

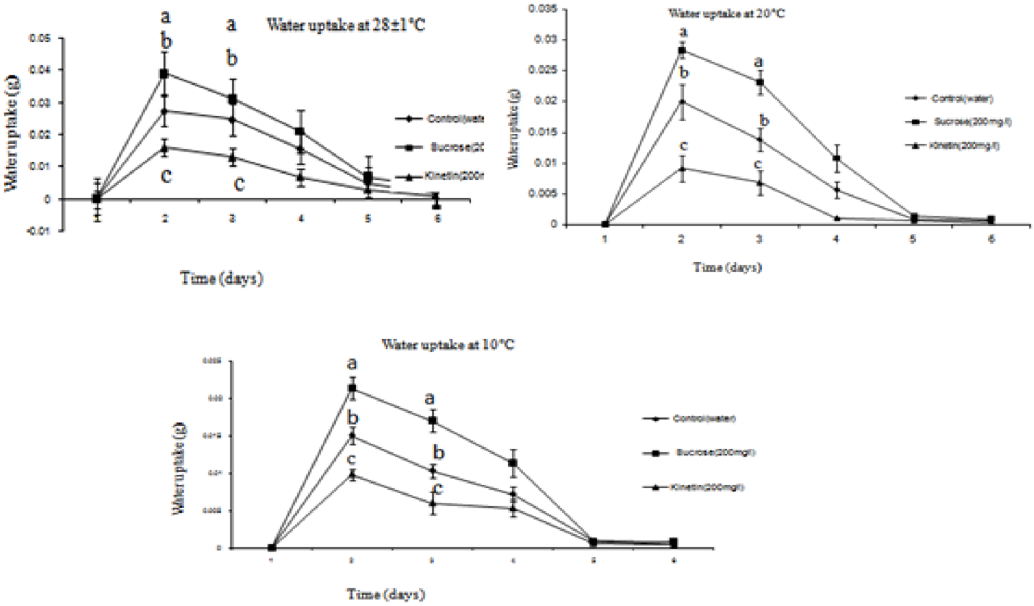

Fig.2. Effects different temperatures of storage on water uptake for *Bougainvillea glabra* bracts versus time (days)

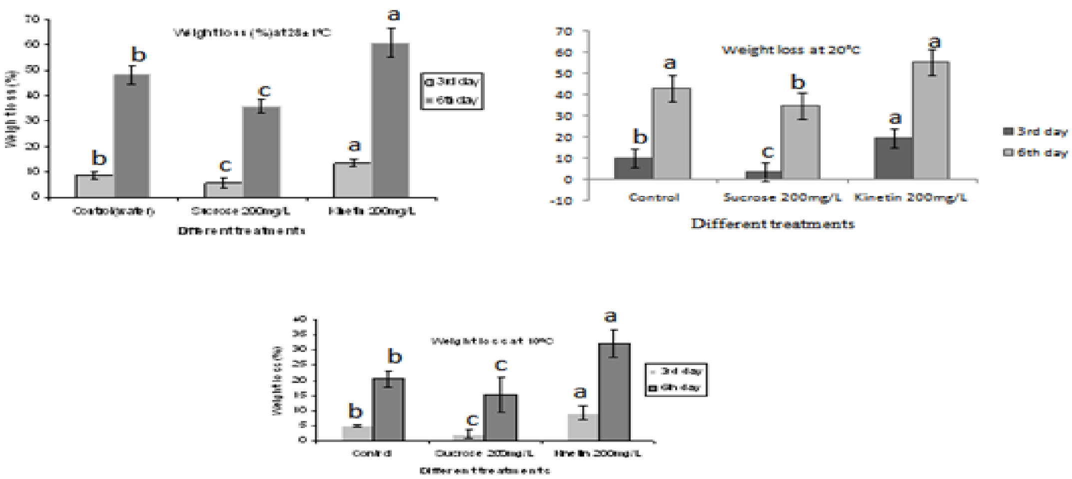

Fig.3. The effect of different temperature of storage conditions on weight loss (%) for *Bougainvillea glabra* bracts.

Water uptake for all the treatments increased up to day 2 and decreased there after. Among the different treatments sucrose showed the highest water up take followed by control and kinetin. The water uptake of Bougainvillea bracts was significantly affected by storage temperature. In case of 28±1ºC, water uptake value (0.04g) of sucrose 200 mg/L at 2nd day and water uptake value (0.021 g) of sucrose 200 mg/L at 2nd day at 10°C.The higher temperature promoted water uptake for all the treatments.

Weight loss

It is seen in Figure 3, bracts held in kinetin 200mg/L showed the highest percentage of weight loss for day 4 (24.6%) and day 6 (60%) at 28±1ºC compared to other treatments. On the other hand sucrose exhibited lowest weight loss at 4th day (11%) and day 6 (35 %) at same temperature. The weight loss of bracts increased with the advancement of storage time. The weight loss (%) of Bougainvillea bracts was significantly affected by storage temperature. Weight loss (%) increased with the proportionate of temperature due to higher water loss. Weight loss (%) initially increased up to the 2nd day of storage irrespective of the different treatments but subsequently decreased linearly. On 6th day, there was only a total of 15% weight loss for the bracts that were treated with 200mg/L sucrose at 10ºC which was mean that the presence of sucrose, an ethylene inhibitor, managed to delay the senescence of bracts compared to other treatments.

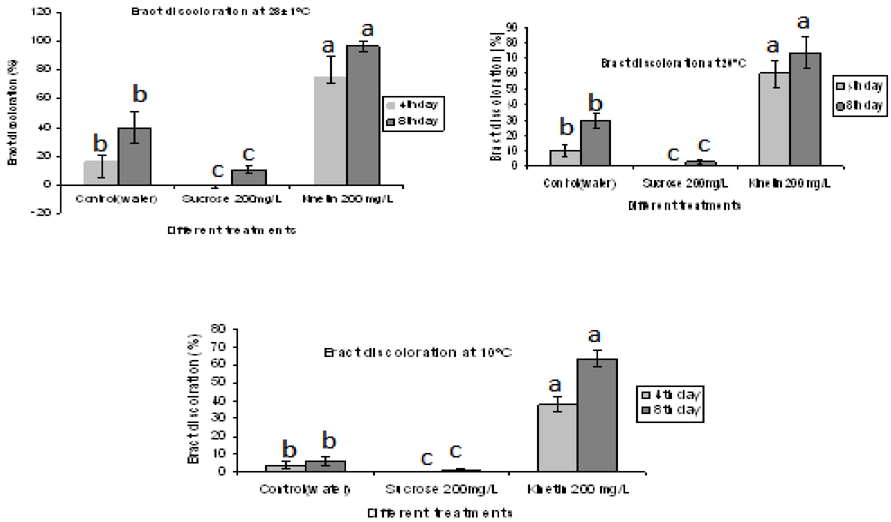

Fig.4. Bract discoloration (%) as affected by different temperature of storage conditions for *Bougainvillea glabra*.

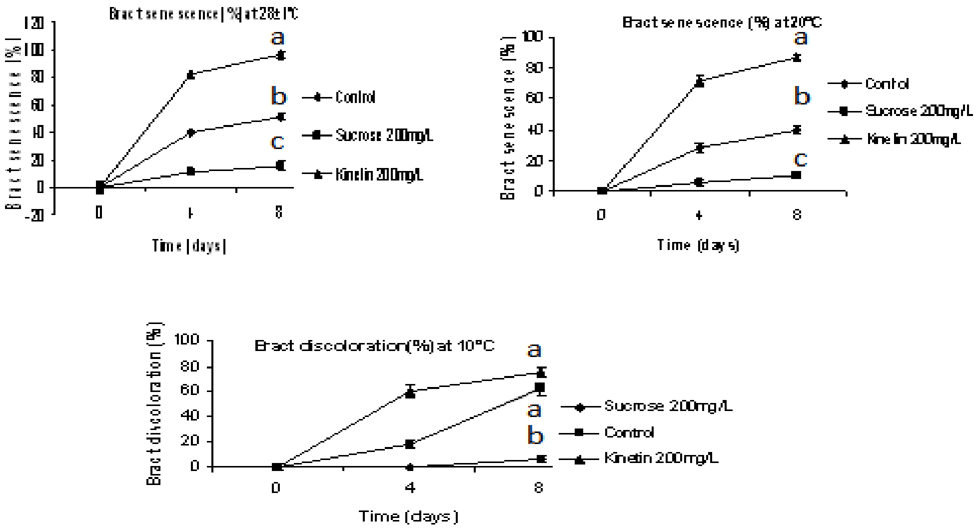

Fig.5. Bract senescence (%) as affected by different temperature of storage conditions for *Bougainvillea glabra*.

Bract discoloration

It was observed that discoloration started earlier in kinetin than in sucrose and water control. The discoloration rates at 4th day were 0% for sucrose, 16% for control and 75% for kinetin at 28±1ºC. Storage temperature was significantly affected the discoloration (%) of Bougainvillea bracts. Discoloration (%) was increased with the increase of temperature. The discoloration (%) was 75% at 28±1ºC, 60% at 20°C, 38% at 10°C for kinetin treatment on the 4th day of observation. At all temperatures, the discoloration was earlier than sucrose and control treatment. The discoloration increased with the increase of storage time.

Senescence

From the result it was shown that senescence started earlier in kinetin and gives the highest value than sucrose and control treatment. Senescence occurrence was shown 86% on 8 DAT at 28±1ºC, 75% on 8 DAT at 20°C and 70% on 8 DAT at 10ºC. Senescence (%) increased with the increase of temperature. At all temperatures, the senescence was earlier in sucrose and

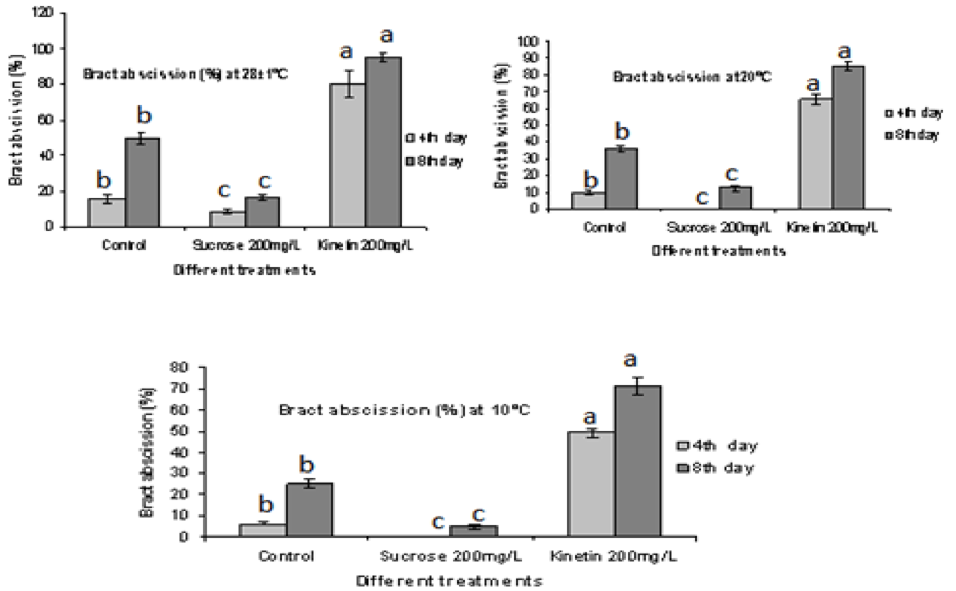

Fig.6. Bract discoloration (%) as affected by different temperature of storage conditions for *Bougainvillea glabra*.

control treatment. The senescence increased with the duration of storage time.

Abscission

It was observed that abscission of bracts significantly affect by treatments and temperature. At all temperatures, abscission (%) was higher in kinetin holding solution. Abscission (%) increased with the increase of temperature. Highest value of abscission (95%) was recorded in kinetin containing solution on 8th day of observation at 28±1ºC and lowest value (0%) was recorded in sucrose containing solution on 4th day of observation at 10ºC. At 10ºC sucrose containing solution showed the best performance.

Discussion

Keeping the bracts in vase solutions containing sucrose has been shown to vase life of flowers Zhuo *et al.* (2005). And this has been proved as a results of Bougainvillea bracts treated with sucrose (200 mg/L) solution showed a longer vase life (12 days) compared to kinetin (200 mg/L) treated flower (7 days). Sucrose yielded the best result because exogenous sucrose may be acted as a continuous supply of energy retaining the turgidity of the bracts. Vase life of bracts reduced in higher temperature because the higher temperature promoting water uptake, senescence, and abscission. It has been reported that the vase life of cut flower has decreased by the increasing storage temperature from 1 to 10°C (Pompodakis *et al.*, 2005). Bacterial contamination of the treatment solutions would be one of the main causes of decreased water uptake in bracts. Sugar may also be maintained water balance. Sucrose showed maximize water uptake and vase life of bracts were much greater than kinetin due to the supply of carbohydrate and carbon availability. Sucrose exhibited lowest weight loss on 4th day (11%) and day 6 (35 %) at 28±1ºC. On the other hand kinetin showed the highest weight loss, it may be due to over concentration used in the experiment. Sucrose help to maintaining water balance and also delays turgur loss as the flower senescence (Sven and Jose, 2004). In this study all the bracts in the different treatments exhibited a decrease in the fresh weight. In some flowers such as cut rose carnations and the flower tissue of morning glory an infiltration of the intercellular spaces of the petals has been shown to be apparent suggesting that there may have been loss of membrane integrity, causing an increase the permeability that leads to a rapid breakdown of cellular compartmentalization together with a parallel increase in the synthesis of ethylene (Pranom *et al.*, 2005). In our results we found that sucrose was more effective to protect discoloration of bract at low temperature compared to kinetin and control treatment. Discoloration is related to ethylene production. Sugars (sucrose) are also to be known to reduce ethylene sensitivity. The results were in agreement with reports by Ichimura *et al.* (1999). Van Doorn *et al.*, (1991), who indicated that vascular blockage in water controls caused water deficit, which shortened the vase life. In case of senescene, sucrose showed the best performance at low temperature than the kinetin and control treatment. Senescence in flower involves a sequence of events in which a rise in ethylene production precedes the increase in membrane permeability (Kanok *et al.*, 2004). This result is similar to those reported by Uda *et al.* (1995) and Ichimura and Ueyama (1998). Sugars are also known to reduce ethylene sensivity and thereby delay the time to senescence in flowers where petal senescence is regulated by endogenous ethylene. Ethylene production increased with the increase of temperature. Abscission of bract is also correlated with ethylene production. Sucrose containing solution showed the lowest percentage of abscission compares to kinetin and control treatment at lower temperature.

Conclusion

From the result it can be concluded that it is possible to extend vase life of bougainvillea bract using sucrose solution at low temperature by causing delay senescence. This is shown by the delayed weight loss and discoloration experienced by the affected bracts and an improve water uptake. Though, literatures were found regarding concentrations of sucrose (200 mg/L) at low temperature (10ºC) were effective in extending vase life and delay abscission of cut carnation flowers. However, in this experiment our result is highlighted the similar effect in bougainvillea bracts.

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