

## Effect of Pre-Treated Chemicals on Keeping Quality and Vase Life of Cut Rose (*Rosa hybrida* cv. 'Yellow Island')

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Nanosilver of nanometer-sized silver ( $\text{Ag}^+$ ) particles (2-5 nm diam) are used in various applications as an anti-microbial. Boric acid ( $\text{H}_3\text{BO}_3$ ) is water soluble (pH=7). Boric acid is ethylene synthase inhibitor and reduce ethylene production through reducing the ACC synthase and ACC oxidase delays senescence of flower. In this study of different concentrations of boric acid and nano-silver was evaluated and vase life, fresh weight loss, flower opening index and the number of bacteria in preservative solution were measured. The highest cut rose flower 'Yellow Island' longevity was obtained in pulse-treated flowers with  $100 \text{ mg l}^{-1}$  boric acid (4 days).

Abstract

**Keywords:** Boric acid, Nanosilver, Rose, Senescence, Vase life.

## INTRODUCTION

Rose (*Rosa hybrida* L.) (Rosaceae) is the most exports of the cut flowers in the worlds (Chamani *et al.*, 2004). A major from of deterioration in cut flowers is the blockage of xylem vessels by air and microorganisms that cause xylem occlusion (Elgimabi and Ahmed, 2009). Symptom for end of vase life petal wilting that is more clear in cut rose (Solomos *et al.*, 1997). Hosseina *et al.*, (2005) belived that before senescence in cut roses, abscission and wilting are two common symptoms. Also, one of most important index for senescence is significant reduction in water uptake and fresh weight of petals. Water balance is a major factor determining quality and longevity of cut flowers. It is influenced by water uptake and transpiration, being the balance between these two processes (Da Silva, 2003). Fructose, glucose and sucrose were the main soluble carbohydrates in petals and stems of cut roses. Fructose was the major component in the petals as well as in stems but, generally, its value was higher than in stems. Sucrose contents in petals and stems were lower than those of glucose (Elgimabi and Ahmed, 2009). Flower opening in cut roses has also been shown to be dependent on carbohydrate levels in petals (van Doorn *et al.*, 1991). In senescing petals, carbohydrate content of petals reduced (Ley-Yee *et al.*, 1992). Ichimura *et al.*, (2003) showed that reduction in soluble carbohydrate in petals, is more important that stem end blockage in longevity of cut rose 'Sonis'.

Nowadays, some of these compounds, such as silver nitrate and silver thiosulfate less applied because it causes blacking of the flower stem and is dangerous for humans and environment (Damunupola and Joyce, 2006). NS is a relatively new antimicrobial compound which is applied as a pulse and preservative solution treatment for cut flowers (Solgi *et al.*, 2009). Nanometer-sized silver ( $Ag^+$ ) particles (NS) are considered to more strongly inhibit bacteria and other microorganisms than  $Ag$  in various oxidation states;  $Ag^0$ ,  $Ag^+$ ,  $Ag^{2+}$ ,  $Ag^{3+}$  (Furno *et al.*, 2004). Boric acid inhibits ethylene production through reducing the ACC synthase and ACC oxidase activities. Used to improve vase life of cut flowers carnations, may be a good competitor as far as price is concerned (Serrano *et al.*, 2001). The present study has investigated the effects of nano-silver and boric acid on improving the quality and extending the vase life of cut rose (*Rosa hybrida* L. cv. 'Yellow Island').

## MATERIALS AND METHODS

Cut roses (*Rosa hybrida* L. cv. 'Yellow Island') were obtained at their optimum developmental stage. They were immediately stood in buckets and transported to the postharvest laboratory. At the laboratory, stems were re-cut under deionized water to ~50 cm length. Re-cutting was to ensure no air blockage of the stem end. The flowers were selected for uniformity of size, color and freedom from any defects. The upper three leaves were retained on each stem.

The experimental design was a randomized completely blocks design (RCBD) with a factorial arrangement of treatments containing four boric acid concentrations (0, 100, 200 and 300 mg/L)  $\times$  four SNP concentrations (0, 5, 10 and 20 mg/L)  $\times$  three replications  $\times$  five cut flowers per treatment. In each experiment, cut rose stems were weighted and pulse-treated for 24 h with 250 mL of preservative solutions (PS) including aforementioned compounds. Then, cut roses were placed individually into the vases filled with 500 mL of preservative solutions containing 3% sucrose and 600 mg/L hydroxy quinoline sulfate. Distilled water was used as a control. The mouths of the vases were covered with a sheet of low density polyethylene film to minimize evaporation and to prevent contamination. Re-cutting was carried out each four days. The flowers were kept in a controlled room under the following conditions:  $20 \pm 2^\circ C$ , relative humidity of 60-70%,  $12 \mu mol\ m^{-2}s^{-1}$  light intensity (cool white flourescent tubes) and a daily light period of 12 h.

### Vase life

Criterion for the end of vase life was the time that flowers were showing symptoms of petals wilting or curling. Vase life was the period from the time of putting the cut flowers into the second preservative solution until the end of vase life.

### Fresh weight loss

Loss of fresh weight (ml g<sup>-1</sup> F.W.) was calculated by the following equation:  
[(initial fresh weight (g) + amount of water uptake (ml)) - [(final fresh weight (g) + weight of recuts (g))].

### Flower opening index

Flower opening was calculated in stage four by digital caliper. For this purpose, the biggest flower diameter plus vertical diameter was calculated and their mean was obtained. Then, flower opening index was calculated from the following formula: (stage 4/stage 3) + (stage 3/stage 2) + (stage 2/stage 1).

### Bacterial counts

150 µl of pulse solution culture on nutrient agar plates and bacterial colonies were enumerated after incubation for 24 h at 25°C. All bacteria counts were made on triplicate sub-samples.

### Statistical analysis

Data were analyzed by SAS software and means were compared by the Tukey's test.

## RESULTS AND DISCUSSION

Based on analysis of variance, significant ( $p \leq 0.01$ ) differences were found among various concentrations of NS and boric acid in extending vase life, fresh weight loss and the number of bacteria. NS and boric acid in the preservative solution had a significant ( $p \leq 0.05$ ) effect on flower opening index.

Boric acid at 100 mg/L significantly extended the vase life of cut rose cv. 'Yellow Island' (Fig. 1). The NS and boric acid pulse treatment at highest concentration (20 mg/L and 300 mg/L, respectively) caused the shortest vase life and resulted in a 0.8 day vase life to the control. Decreasing the vase life of cut flowers held in the highest concentration of NS and boric acid is due to the toxic effects of these materials. Positive effect of NS on extending of vase life in other flowers such as rose, gerbera and lily has been demonstrated (Lu *et al.*, 2010; Liu *et al.*, 2009; Solgi *et al.*, 2009; Kim *et al.*, 2005). Serrano *et al.*, (2001) revealed that a 24-h pulse treatment with the preservative solution containing 50, 75 or 100 mM boric acid or continuous treatment with 1 mM boric acid resulted in significantly increasing cut carnation flowers longevity.

In control plants, the reduction of fresh weight is more considerable. The loss fresh weight is lower in 100 and 200 mg/L boric acid. Interaction between BA and SNP significant on loss of fresh weight ( $p \leq 0.01$ ) and 300 mg/L BA + 10 mg/L SNP had the lowest loss of fresh weight. With increasing of BA concentration, the loss of fresh weight was slower and 10 mg/L SNP had lower loss of fresh weight in comparison to 5 and 20 mg/L, SNP reduced stem and blockage ( Fig. 2).

van Doorn (1997) suggested that, loss of fresh weight, is one of the symptoms for senescence. This feature is more clear in cut rose. Changes in relative fresh weight (RFW) of cut roses showed similar trends for both control and NS pulse treatments, such that RFW increased until day 3 after harvest and decreased thereafter (Lu *et al.*, 2010).

The lowest rate opening of flowers was showed is control flowers. The most important reason for senescence of flowers before full blooming, was ethylene. The highest rate of flower opening was observed in 100 mg/L BA. Effect of SNP not significant on this (Fig. 3). Totally, full

blooming of cut flowers needs to carbohydrates to water uptake and turgidity of cells, increasing of carbohydrate to preservative solutions, improved water uptake and flower blooming and delayed senescence.

Since flower opening is a process which needs ATP and the required ATP should be produced through respiration; therefore, each factor that reduced the plant respiration, can delay the flower opening process (Hashemabadi and Mostofi, 2007).

Numbers of bacteria on the pulse solution decreased significantly with increasing of NS and boric acid concentration. There were significant differences in numbers of bacteria on the solution between the 20 mg/L NS along with 300 mg/L boric acid pulse treatment and the control for the duration of assessment.

The highest concentration of NS and boric acid is due to the toxic effects of these materials. It is important to note that in pulse-treated flowers with the preservative solutions containing NS and boric acid, vase life was not increased in line with increasing the boric acid and NS concentrations (Fig. 4).

Liu *et al.* (2009) demonstrated that NS inhibited bacteria growth for the first 2 d of vase life in stem ends of cut gerbera. Ag<sup>+</sup> concentrations in tissues rose with an increase in NS concentration in the pulse solution. Ag<sup>+</sup> concentrations of basal stem ends were generally higher than those of upper stem ends, leaves and petals (Lu *et al.*, 2010).

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## **Tables**

Table 1. Mean comparison of single different concentrations of boric acid and nanosilver on measured characteristics.

<b>Treatments</b>	<b>Vase life (day)</b>	<b>Fresh weight loss (g)</b>	<b>Flower opening index</b>	<b>The number of solution bacteria (Log<sub>10</sub> (CFU) ml<sup>-1</sup>)</b>
B0 (0 mg l <sup>-1</sup> )	7.25ab	4.41a	1.09b	1.25a
B1 (100 mg l <sup>-1</sup> )	8.53a	3.92ab	2.04a	1.18a
B2 (200 mg l <sup>-1</sup> )	7.02b	3.76ab	1.95ab	0.87b
B3 (300 mg l <sup>-1</sup> )	7.10ab	3.75b	1.94ab	0.81b
N0 (0 mg l <sup>-1</sup> )	8.17a	3.40c	2.04a	1.81a
N1 (5 mg l <sup>-1</sup> )	7.10b	4.11ab	1.91a	1.05b
N2 (10 mg l <sup>-1</sup> )	7.62ab	3.95b	1.96a	0.82b
N3 (20 mg l <sup>-1</sup> )	7.01b	4.39a	1.93a	0.42c

In each column means followed by the same letters are not significantly different at 5 % level of probability using DMRT.

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**Figures**

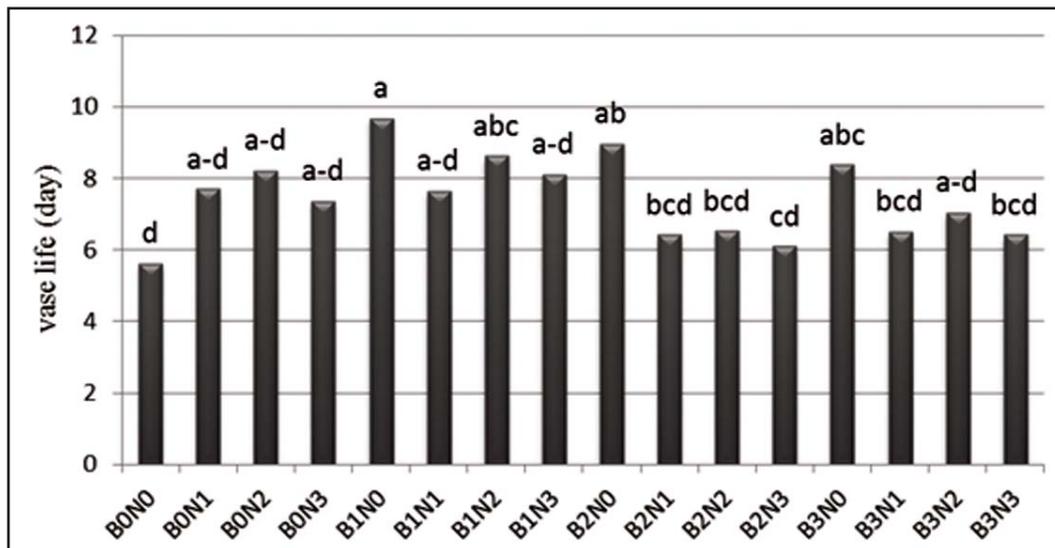


Fig. 1. Intraction boric acid and nanosilver on the vase life of cut rose cv. 'Yellow Island'.

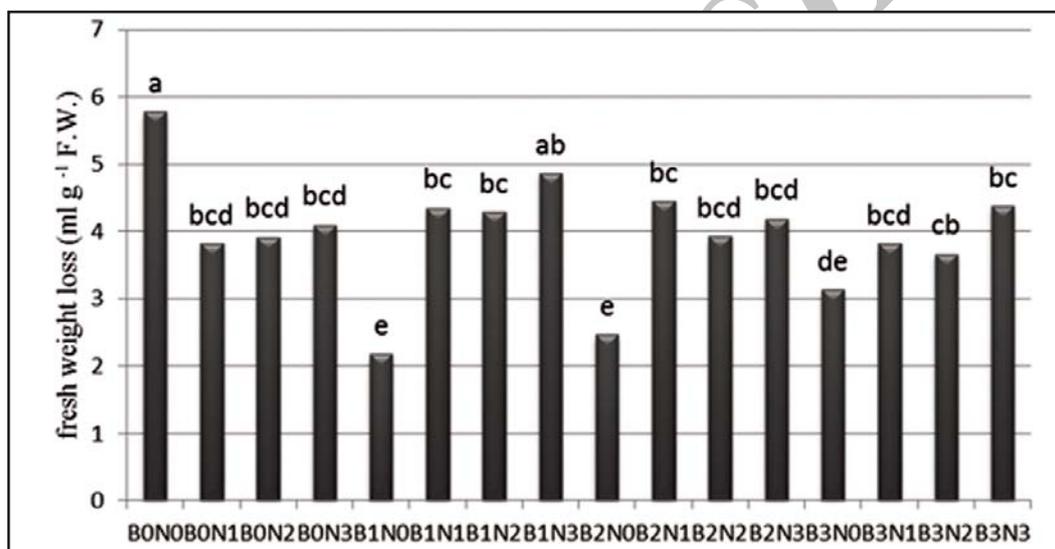


Fig. 2. Intraction boric acid and nanosilver on the fresh weight loss of cut rose cv. 'Yellow Island'.

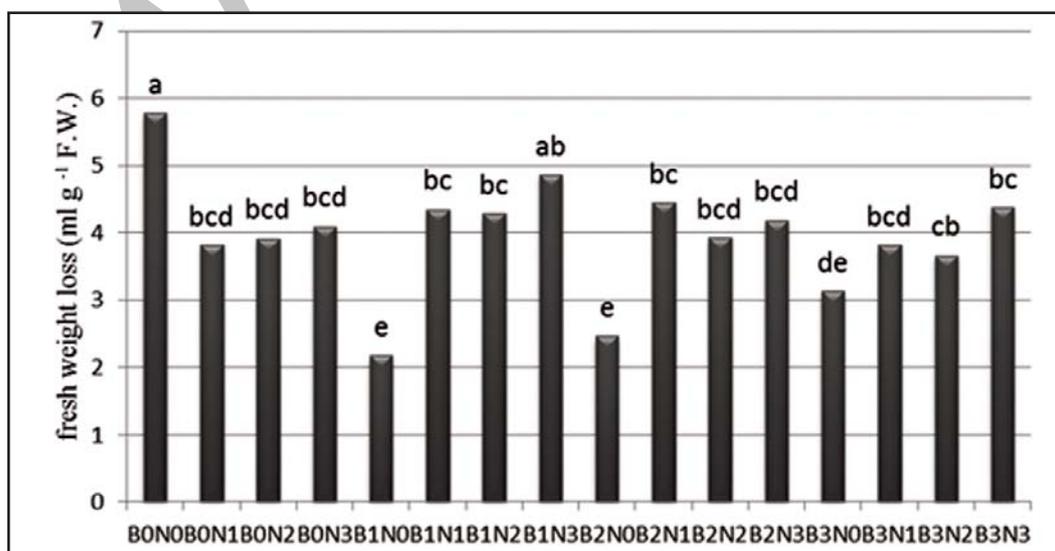


Fig. 3. Intraction boric acid and nanosilver on the flower opening index of cut rose cv. 'Yellow Island'.

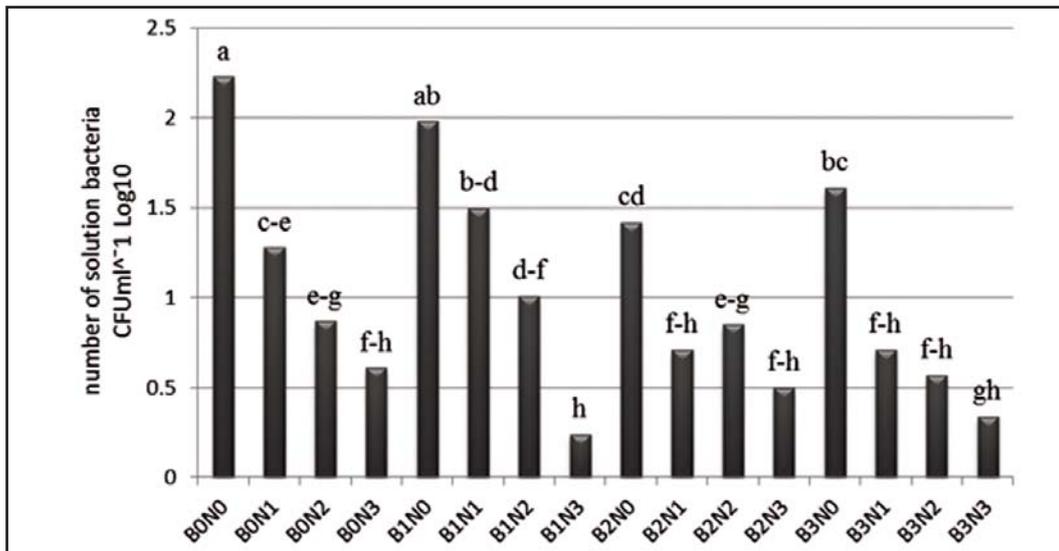


Fig. 4. Interaction boric acid and nanosilver on the number of solution bacteria of cut rose cv. 'Yellow Island'.

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