



## Effects of salicylic acid and citric acid treatments on some parameters of *Narcissus tazetta* L. during vase life

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**Abstract:** This study aimed to assess the effect of salicylic and citric acid applications on the vase life, relative fresh weight, water uptake, bud opening change and total water uptake of cut narcissus. In the research, flowers were harvested at the unbloom goose-neck stage. As applications, purified water (T1- control), 300 ppm (T2) and 150 ppm (T3) salicylic acid, 150 ppm (T4) and 50 ppm (T5) citric acid were determined. In the research, vase life, bud opening change, water uptake and total water uptake were found to be higher in T5 application compared to other applications. It was observed that T2 application was more effective in increasing the relative fresh weight as 112%. The highest doses of growth regulators caused damage at the bottom of flower stems. As a result, it was found that treatments applied in low doses as 150 ppm salicylic acid and 50 ppm citric acid on the investigated parameters of *Narcissus tazetta* flower were more effective.

**Keywords:** Cut flower, plant growth regulators, relative fresh weight, vase life, water uptake

## Vazo Ömrü Süresince *Narcissus Tazetta* L.'nin Bazı Parametreleri Üzerine Salisilik Asit ve Sitrik Asitin Ekileri

**Öz:** Bu çalışma kesme nergis çiçeğinin vazo ömrü, nispi taze ağırlık, su alınımı, gonca açma değişimi ve toplam su alınımı üzerine salisilik ve sitrik asit uygulamalarının etkisini değerlendirmeyi hedeflemiştir. Araştırmada çiçekler açmamış gonca safhasında (goose-neck) hasat edilmiştir. Çalışmada uygulama olarak saf su (T1- kontrol), 300 ppm (T2) ve 150 ppm (T3) salisilik asit, 150 ppm (T4) ve 50 ppm (T5) sitrik asit belirlenmiştir. Araştırmada vazo ömrü, gonca açma değişimi, su alınımı ve toplam su alınımı T5 uygulamasında diğer uygulamalara göre daha yüksek bulunmuştur. Nispi taze ağırlığı artırma da (%112) ise T2 uygulamasının daha etkili olduğu görülmüştür. Gelişim düzenleyicilerin yüksek dozları, çiçek saplarının dip kısmında zararlanmalara neden olmuştur. Sonuç olarak *Narcissus tazetta* çiçeğinin incelenen parametreleri üzerine 150 ppm salisilik asit ve 50 ppm sitrik asit gibi düşük dozlardaki muamelelerin daha etkili olduğu ortaya çıkarılmıştır.

**Anahtar Kelimeler:** Bitki gelişim düzenleyicileri, kesme çiçek, nispi taze ağırlık, su alınımı, vazo ömrü

### 1. Introduction

Cut flowers are the most significant commercial products in the floriculture industry (Zencirkiran, 2005; Solgi et al., 2009). *Narcissus* are among the most requested cut flowers by consumers in the world due to its beautiful appearance, fragrance and multiple flower structure, (Ali et al., 2009; Gul and Tahir, 2012; Gun and Ozturk, 2019). The interest in cut flowers is increasing day by day depending on especially sectoral developments and the increase in purchasing power of consumers. The

post-harvest life of cut flowers is critical in determining the value of the flowers in the market (Bayat and Aminifard, 2017). In addition, the cut flowers with short vase life are difficult to market without loss of quality (Singh et al., 2007). In this respect, it is extremely significant to maintain the quality of cut flowers and to increase their vase life. Halevy (1976) stated that the most significant reason limiting the vase life of cut flowers is water stress. Microorganisms that multiply in vase water block up the vascular bundles of flowers and

obstruct water uptake, thus they cause the flowers to undergo water stress (Van Doorn and Perik, 1990).

Kazemi et al. (2010) stated that when vascular blockages occurs in the stems of cut flowers, the water loss occurs with respiration in the flowers, as a result, the vase life is shortened. The ending of vase life in cut flowers is explained with the wilting of flowers due to the loss of water in the cells (Vinodh et al., 2013). Many growth regulators and chemicals are used to increase the vase life by reducing the quality losses in the cut flowers (Halevy and Mayak, 1981; Solgi et al., 2009; Soad et al., 2011).

Citric acid (CA), which is an organic acid found in plants, is a growth regulator commonly used to control bacterial proliferation in flower stems and vase solution due to its water acidification property (Nowak, 1990; Dole and Wilkins, 2005). It reduces the risk of vascular blockage in the cut flowers due to these properties. (Bhattacharjee et al., 1993). It is used as a preservative in the vase solution of cut flowers such as especially chrysanthemum (Dole et al., 1999) and liliium (Rida et al., 2016). Salicylic acid (SA), a natural hormone, plays a significant role in increasing the resistance of plants to biotic and abiotic stress (Mayak and Halevy, 1980). Salicylic acid, which has the potential to the decreasing the pH of water, prevents the growth of bacteria in the vase solution (Raskin, 1992; Popova et al., 1997; Bleeksma and van Doorn, 2003). In the previous studies, it had been reported that SA increased vase life of many cut flower species (Dole and Wilkins, 2005; Bleeksma and van Doorn, 2003; Hayat et al., 2010; Vahdati et al., 2012; Bayat and Aminifard., 2017). Our hypothesis is that vaso life of *Narcissus tazetta* flower can be extended with citric acid and salicylic acid applications. Therefore, in this study, it was aimed to determine the effect of citric acid and salicylic acid applications on the vase life of *Narcissus tazetta* flower.

## 2. Materials and Methods

### 2.1. Plant materials

In the experiment, *Narcissus tazetta* species, which grows naturally in Ordu, Persembe district, was used as plant material. The cut narcissus flower was harvested by hand at the goose-neck stage on December month in 2018 years. In the study, 75 narcissus flowers was used in total. The harvested flowers were transferred to Ordu University, Faculty of Agriculture, Horticulture Department, Post-Harvest Physiology Laboratory within 1 hour. The cutting was made from the lower part of the stem to be approximately 35 cm. length of the flower stalks. Then the flowers were put in vases containing pure water (T1), 300 ppm salicylic acid (T2), 150 ppm salicylic acid (T3), 150 ppm citric acid (T4) and 50 ppm citric acid (T5) solution. While vase solution was preparing, the pure water was used in all applications. The vase life trial was conducted under conditions of  $21 \pm 1$  ° C and  $65 \pm 5\%$  relative humidity. The parameters such as vase life, relative fresh weight, change of buds opening, water uptake and total water uptake in flowers were investigated. The measurements were performed in 3 day intervals. The experiment was designed with 3 replications and 5 flowers were used in each repetition.

### 2.2. Methods

#### Vase life (days)

It was determined as the number of days passed from the day when the flowers are placed in the vase until the day 50% of the petals wilting (Alipur et al., 2013).

Relative fresh weight (%):

$$\text{RFW (\%)} = (A_t / A_{t=0}) \times 100 \quad (1)$$

$A_t$ : weight of stem (g) at t = day (eg 1, 3, 5 etc.)  $A_{t=0}$ : weight of the same stem (g) at t=day 0 (He et al., 2006).

Daily water uptake:

$$\text{DWU} = S_{t-1} - S_t \quad (2)$$

$S_{t-1}$  = the weight of vase solution for the previous day,  $S_t$  = the weight of vase solution on day t (eg 1, 2, 3, etc.) (He et al., 2006).

Total Water Uptake:

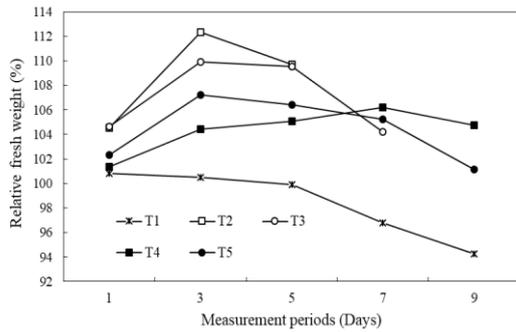
TWU = Refers to the total daily water uptake at the end of the vase life.

Opened Bud Change (%):

OBC = It was determined by proportioning unbloomed buds with the total blooming flowers on a stem (Mir Saeed Ghazi et al., 2013).

### 2.3. Statistical analysis

At the result of the control done, the descriptive statistics of the data fulfilling the conditions were calculated and evaluated with variance analysis. After the data obtained were analyzed with analysis of variance (ANOVA), the level of significance between treatments was determined by Tukey's multiple comparison test. Statistical analyzes was done in MINITAB 17 package program. The significance level in statistical analyzes and interpretation of the results was taken into account as  $\alpha = 5\%$



**Figure 1.** The effect of different application on relative fresh weight during vase life of narcissus flower

*Şekil 1. Nergis çiçeğinin vazo ömrü süresince nispi taze ağırlık üzerine farklı uygulamaların etkileri*

T1: control, T2: 300 ppm SA, T3: 150 ppm SA,  
T4: 150 ppm CA, T5: 50 ppm CA.

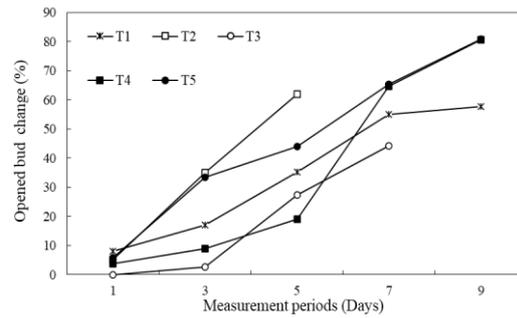
### 3.2. Vase life

Vase life of T2, T3 and T4 applications was found to be significantly shorter compared to control (T1) application. However, it was observed that the vase life of narcissus flowers

## 3. Results

### 3.1. Relative fresh weight and opened bud change (%)

The effects of the different vase solutions on the relative fresh weight of cut Narcissus flower during the vase life were shown in Figure 1. The relative fresh weight of Narcissus during the life of the vase was 112% in T2 application, in T3 application, it increased up to approximately 110%. However, in T1 (control) application, the highest relative fresh weight was measured as approximately 100%. T2 and T5 applications were more effective in increasing fresh weight. At the end of the vase life, 58% of the flowers on a stem in T1 application opened, while 81% in T5 application opened. When Figure 2 was examined, compared to the control, T3 and T4 applications delayed the blooming of flowers, while T2 and T5 accelerated the applications.

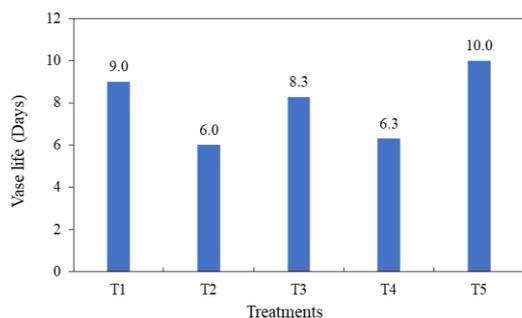


**Figure 2.** The effect of different application on opened bud change during vase life of narcissus flower

*Şekil 2. Nergis çiçeğinin vazo ömrü süresince açmış gonca değişimi üzerine farklı uygulamaların etkileri*

T1: control, T2: 300 ppm SA, T3: 150 ppm SA,  
T4: 150 ppm CA, T5: 50 ppm CA

belonging to T5 application was significantly longer compared to both control and other applications. The lowest vase life was detected at high doses of SA (300 ppm- 6 day) and CA (150 ppm- 6.3 day) (Figure 3)



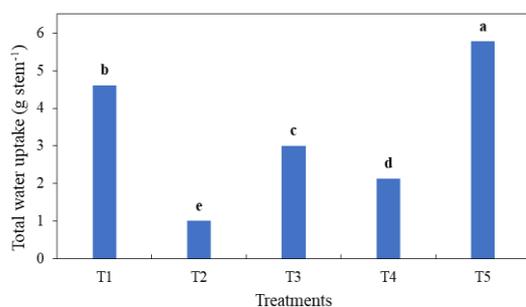
**Figure 3.** The effect of different application on vase life of narcissus flower

*Şekil 3. Nergis çiçeğinin vazo ömrü üzerine farklı uygulamaların etkileri*

T1: control, T2: 300 ppm SA, T3: 150 ppm SA,  
T4: 150 ppm CA, T5: 50 ppm CA.

### 3.3. Daily water uptake

The water uptake of narcissus flowers of all applications increased until the 5th day, T1, T3 and T5 applications decreased on the 7th day, then in T1 and T5 applications increased. In general, lower water uptake was observed from narcissus flowers treated with SA and CA solutions compared to the control (Figure 4).



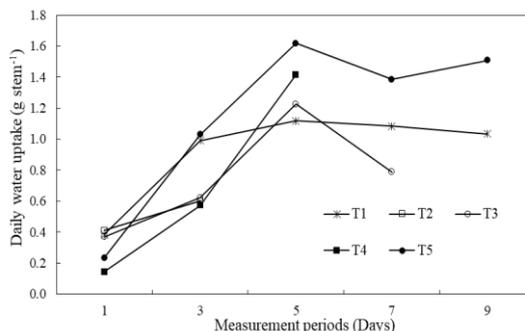
**Figure 5.** The effect of different application on total water uptake (g stem<sup>-1</sup>) during vase life of narcissus flower

*Şekil 5. Nergis çiçeğinin vazo ömrü süresince toplam su alımı üzerine farklı uygulamaların etkileri*

T1: control, T2: 300 ppm SA, T3: 150 ppm SA,  
T4: 150 ppm CA, T5: 50 ppm CA

### 3.4. Total water uptake

The highest total vase solution uptake was determined at T5 application with 5.8 ml. Total water uptake of T2, T3 and T4 applications was



**Figure 4.** The effect of different application on daily water uptake (g stem<sup>-1</sup>) during vase life of narcissus flower

*Şekil 4. Nergis çiçeğinin vazo ömrü süresince günlük su alımı üzerine farklı uygulamaların etkileri*

T1: control, T2: 300 ppm SA, T3: 150 ppm SA, T4:  
150 ppm CA, T5: 50 ppm CA

significantly lower than control (T1). However, significantly lower water uptake was measured from 300 ppm SA application compared to 150 ppm SA and CA applications (Figure 5).

## 4. Discussion

Microorganisms that develop in vase solution cause decrease in vase life and deterioration by causing the blockage in the stems of cut flowers (Macnish et al., 2008). In this respect, in the study, the different growth regulators were used as a vase solution. It was determined that salicylic acid applications have a shorter vase life compared to the control. However, the lower dose of salicylic acid (150 ppm) had a longer vase life than the higher dose (300 ppm). Contrary to our findings, the addition of salicylic acid to the vase water of the rosa resulted in an increase in vase life (Capdeville et al., 2003). Again, salicylic acid applied to flowers such as Peruvian lily, gerberas, lily, rose and tuberose (Bayat and Aminifard, 2017), carnation (Kazemi et al., 2012) and chrysanthemum (Vahdati et al., 2012) increased the vase life. Similar to our findings, it was reported that low-dose salicylic acid applied to cut iris (Ramzan et al., 2018) and carnation flowers (Kazemi et al., 2012) had a longer vase life compared to high dose. This difference in the findings is thought to be due to the cut flower species and the application dose.

The addition of citric acid to the vase solution increased the vase life of narcissus (Bayat and Aminifard, (2018) and gladiolus (Hasanpour Asil and Hasani, 2012) flowers. But Jowkar et al., (2012) stated that it was not effective in increasing the vase life of the cut rose. In our study, the citric acid application significantly increased the vase life compared to salicylic acid application. It was determined that the most effective dose was 50 ppm citric acid. Bayat and Aminifard (2018) stated that the most effective dose in narcissus was 100 ppm and 300 ppm. In our study, 150 ppm citric acid dose had a shorter vase life compared to a 50 ppm dose. Van Doom and Perik (1990) and Knee (2000) reported that the biocides may have a toxic effect depending on their dose in reducing the vase life. In this respect, it is thought that the effect of salicylic acid and citric acid applications in reducing the vase life in our study is due to their toxic effect. The fresh weight losses in cut flowers is due to decreased water uptake and increased water loss through transpiration (Borochoy et al., 1995; Rattanawisalanon et al., 2003; Liao et al., 2012; Mansouri, 2012). In the previous studies, Jowkar (2006) and Bayat and Aminifard (2018) reported that the fresh weight of narcissus flower, which was applied citric acid during the vase life, increased with increased water uptake. In another study, citric acid increased the water uptake and the fresh weight of lisianthus flower (Sheik et al., 2014). However, in our study, the fresh weights of narcissus flowers treated with citric acid were higher than control, while water uptake was higher at only 50 ppm dose.

Similarly, Mostafa et al. (2020) stated that although the relative fresh weight of the *Asparagus densiflorus* plant, which they applied citric acid, was higher during the vase life, the water uptake was lower. Salicylic acid increased the water uptake and the fresh weight of carnation flower (Vahdati et al., 2012) and 5 different cut flower species (Bayat and Aminifard, 2017). It is thought that the increase in water uptake and fresh weight of the flowers is due to the stress-relieving and acidifying properties of salicylic acid. Contrary to these findings, Sardoei et al. (2013) reported that

salicylic acid applied narcissus flower had less water uptake and fresh weight. In our study, it was determined that the fresh weight of the flower treated with salicylic acid was higher and the water uptake was less than the control. However, Kazemi et al. (2012) reported that the water uptake and the fresh weight of chrysanthemum flower increased with low dose salicylic acid application.

Jowkar (2006) reported that it may cause a decrease in water uptake and an increase in fresh weight loss due to its toxic effect on flowers depending on the component and the concentration of the component used in the vase solution, it may cause a decrease in water uptake and an increase in fresh weight loss due to its toxic effect on flowers. In our study and other studies, it is thought that the decrease in the fresh weight and the water uptake is due to the toxic effect occurred depending on the dose of the applications used in the solution. In our study, it was determined that the most effective application on the fresh weight and the water uptake was 50 ppm citric acid. The highest bud opening value was obtained from 300 ppm salicylic acid and 50 ppm citric acid applications. In another study (Ghale-shahi et al., 2015), it was found that the low-dose orange extract containing citric acid was effective in opening bud in narcissus flowers. Uddina et al., (2016) reported that the highest blooming bud value of tuberose flower was obtained from 50 ppm citric acid and salicylic acid applications with sugar. At the end of the vase life, the highest total water uptake was obtained from 50 ppm citric acid. Similarly, Bayat and Aminifard (2018) stated that the highest total water uptake in narcissus flowers is in citric acid application. On the contrary, it was determined that the total water uptake of the *Asparagus densiflorus* plant treated with citric acid was lower (Mostafa et al., 2020). In our study, less total water uptake occurred in other applications than in control.

As a result, in the study, it was revealed that 50 ppm citric acid dose is more effective on vase life and other parameters. It is recommended to determine the different applications and their most effective doses to

delay the aging of cut narcissus and different flower species and to increase the vase life.

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