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# Effect of Pre-harvest Foliar Application of Benzyl adenine and Salicylic acid on Carnation cv. Spray and Standard

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**ABSTRACT: Carnation is one of the popular cut flowers that due to short vase life and loss of quality prove postharvest problems. In this research, effect of salicylic acid (SA) and benzyl adenine pre-harvest spraying on morphological traits of carnation has been investigated. The experimental design was a factorial experiment in form of CRD design with three replications. During this experiment effects of spraying plant growth regulators with different concentrations and different cultivars of carnation as two factors were studied (salicylic acid 50 µM, salicylic acid 100 µM, salicylic acid 200, benzyl adenine 50 µM, benzyl adenine 100 µM, benzyl adenine 150 µM, and control) and different cultivars (spray, and standard Results of this study revealed that applying of salicylic acid increased vase life cut carnations and increased total length of plants and benzyl adenine lead to all studied traits. In order to the current study it concluded that the spraying benzyl adenine 50 µM was the most effective treatment on all of traits.**

**Keywords:** carnation, vase life, pre-harvest, vase solution, salicylic acid, benzyl adenine

## INTRODUCTION

Carnation (*Dianthus caryophyllus* L.) is one of the world's most popular cut flower. The magnitude of this ornamental flower is due to its attractiveness, first-rate quality, and wide range of different forms (Kharrazi *et al*., 2011). Carnation, in the family Caryophyllaceae, can be found in anextensive diversity of colors and is a model system for studies of flower senescence. In addition, it is one of the most important flowers in the world wide floriculture commerce, and hundreds of cultivars of carnation are grown everywhere in the world. Dianthus is a genus that has about 300 species in the Caryophyllaceae family (Tanase *et al*., 2012). Accordingly, it is one of the largest genera of vascular plants in the world. The Dianthus species originated in the northern temperate areas of Europe, Asia, North America, and North Africa and are also growing in Mediterranean coastal regions (Behroozian, *et al*., 2013). Several species, including *Dianthus caryophyllus, D. barbatus, D. chinensis, D. plumarius, D. superbus*, and their hybrids are widely used as horticultural cultivars. Many flower varieties of carnation are allocated into three groups (standards, sprays, and pot carnations) based on plant form, flower size, and flower shape. Standards have a single large flower per stem, whereas sprays have a larger number of smaller flowers; both types are used for cut flowers. Pot carnation is a dwarf with many small flowers that is used as a potted plant. Most carnation cultivars are diploid (2n = 2x = 30), although some species of Dianthus are tetraploid or hexaploid (Tanase *et al*., 2012). Today's commercial carnations are the product of more than 200 years breeding, carnations of present day flower year around, and have a wider color range, large flower size and sturdier stems than their wild families (Sharma *et al*., 2013).

Cytokinins are known to postpone leaf senescence and ameliorate the keeping qualities of cut carnations and roses (Eisinger, 1977). Cytokinin action in plant tissue is relayed on the type of cytokinin, internal movement of cytokinins and adjustment by other plant growth hormones, such as ethylene and auxin (Setyadjit *et al*., 2004). Cytokinins as plant-specific chemical messengers (hormones) participate in an essential role in the regulation of the plant cell cycle and numerous developmental procedures. Cytokinins were found out as factors that stimulate cell division Cytokinins exist in all plant tissues. The shoot apex, root tip, and immature seeds are sites of cytokinin accumulation in plant. Their endogenous concentration is in the low amounts about nM range. Typically, several kinds of cytokinins and their modified forms are present in a certain tissue. Cytokinins can perform over long distances or in the direct vicinity of the cytokinin producing cells (paracrine signaling). Cytokinins may act also on the cell that produced them (autocrine signaling) (Schmulling, 2004). Salicylic acid (SA) is a new phenolic phytohormone, which takes part in the adjusting different physiological processes in plants. The SA has been shown to interfere with the inhibition of ethylene production and promotion of stomatal closure (Nikkhah-Bahrami, 2013).

The application of natural compounds and physical treatments for postharvest produce has been replaced. Salicylic acid (SA) is one of natural and harmless chemicals used for postharvest quality conservation of horticultural and ornamental produces. Recently, many postharvest technologies for fresh and perishable produces including fruit, vegetables and ornamentals have been accepted where salicylic acid is in use. Salicylic acid, as a simple plant phenolic compound, is known as an endogenous signal molecule regulating plant developmental processes and moderating both biotic and abiotic stresses (Supapvanich & Promyou, 2013). The signal molecules salicylic acid (SA) is endogenous plant growth material that shows important effects in plant growth and development, and responses to environmental stresses. These signal molecules are involved in some signal transduction systems, which persuade specific enzymes catalyzing biosynthetic reactions to form defense compounds such as polyphenols, alkaloids or pathogenesis-related (PR) proteins (Yao & Tian, 2004). Salicylic acid (SA) has been considered a new potential alternative for this purpose and has been found to influence various physiological and biochemical functions in plants (Alaey *et al*., 2011). The purpose of this experiment was to evaluate effects of plants growth regulators and proper concentrations on two cultivars of carnations of them.

## MATERIAL AND METHODS

This experiment was conducted in the crop years 2014-2015 at the experimental greenhouse of Varamin near city of Tehran, Iran (51° 64' E, 35° 32' N and 918 m above the sea level). The experimental design was a factorial experiment in form of CRD design with three replications. During this experiment effects of spraying plant growth regulators with different concentrations and different cultivars of carnation as two factors were studied (A1= Salicylic acid 50 µM, A2= Salicylic acid 100 µM, A3= Salicylic acid 200, A4= Benzyl adenine 50 µM, A5= Benzyl adenine 100 µM, A4= Benzyl adenine 150 µM, and control) and different cultivars (B1= Spray, and B2= Standard). Plants were sprayed two times, first spraying was performed before bud opening and another spraying was performed three days before harvest. Total Length of plants, water content, floret length, and floret diameter at the time of harvest were measured. Also vase life of cut flowers and dry weight were determined.

## RESULTS

Results of variance analysis (Table 1) showed treatments include Sprayed hormones and Cultivars had significant effects on all of studied traits (P≤0.01). And also interaction of Hormones × Cultivar had significant effects on water content and total length (P≤0.01) and also affected on Dry weight and floret size significantly (P≤0.05). Comparison of Means revealed that the most water content is gained by spraying plants by benzyl adenine 50 µM (8.973%) which is about two folds more than control (4.426%). Also spraying with benzyl adenine at concentrations, 50 µM and 100 µM caused the highest dry weights (0.356 and 0.3457 respectively) while dry weight in control was 0.1958. vase life of plants that were being sprayed with salicylic acid 100 µM, benzyl adenine 50 µM, and benzyl adenine 100 µM were higher than other treatments (13.167, 12.17, and 12.00 days respectively) although there was no significant difference between those treatments. The most length in plants were obtained by applying benzyl adenine at concentrations, 50 µM and 100 µM, and salicylic acid 100 µM (63.137, 61.784, and 60.619 cm respectively) while the lowest length was related to control. About floret length and floret diameter, the most amounts are obtained by treating plants with benzyl adenine at concentrations, 100 µM and 50 µM (4.768 cm and 4.756 cm in floret length, and 1.705 cm and 1.685 cm in floret diameter respectively) whereas control has the lowest length and diameter of florets (Table 2). Comparison of Means for cultivars showed that standard carnations had more water content (7.843%) than sprays (5.601%). Also standard carnations had more vase life (11.857 days), floret length (4.578 cm), and floret diameter (1.793 cm) in return; spray carnation had more dry weight (0.323) and total length (64.505cm) (Table 3).

**Table 1: Variance of analysis results for three studied factors.**

| S.O.V. | df | Means of square | | | | | |
|---|---|---|---|---|---|---|---|
| | | Water content | Dry weight | Vase life | Total length | Floret length | Floret diameter |
| **Hormones** | 6 | 14.089$^{**}$ | 0.0202$^{**}$ | 37.769$^{**}$ | 189.2402$^{**}$ | 0.445$^{**}$ | 0.0618$^{**}$ |
| **Cultivar** | 1 | 52.81$^{**}$ | 0.083$^{**}$ | 133.929$^{**}$ | 2375.192$^{**}$ | 0.3189$^{**}$ | 1.8957$^{**}$ |
| **Hormones × Cultivar** | 6 | 2.07$^{**}$ | 0.003$^{*}$ | 2.817 | 29.538$^{**}$ | 0.0534$^{*}$ | 0.0023 |
| **Error** | 28 | 0.581 | 0.001 | 1.47 | 6.12 | 0.016 | 0.00224 |

*, Significant at P ≤ 0.05; **, Significant at P ≤ 0.01.

**Table 2: Mean comparisons of main effects of characters.**

| Hormones | Water content | Dry weight | Vase life | Total length | Floret length | Floret diameter |
|---|---|---|---|---|---|---|
| 50 µM Salicylic acid | 5.578 E | 0.236 C | 10.167 B | 60.6192 A | 4.649 AB | 1.618 B |
| 100 µM Salicylic acid | 7.1225 C | 0.2972 B | 13.167 A | 57.173 B | 4.525 BC | 1.604 B |
| 200 µM Salicylic acid | 6.097 DE | 0.26 C | 8.83 BC | 54.478 B | 4.2972 D | 1.513 C |
| Benzyl adenine 50 µM | 8.973 A | 0.356 A | 12.17 A | 63.137 A | 4.7565 A | 1.685 A |
| Benzyl adenine 100 µM | 8.097 B | 0.3457 A | 12.00 A | 61.784 A | 4.768 A | 1.705 A |
| Benzyl adenine 200 µM | 6.762 CD | 0.258 C | 7.67 CD | 54.948 B | 4.428 CD | 1.516 C |
| Control | 4.4268 F | 0.1958 D | 6.5 D | 46.753 C | 4.0118 E | 1.423 D |

Means in a column followed by the same letter are not significantly different at 5% level.

**Table 3: Mean comparisons of main effects of characters.**

| Cultivars | Water content | Dry weight | Vase life | Total length | Floret length | Floret diameter |
|---|---|---|---|---|---|---|
| Spray | 5.601 B | 0.323 A | 8.286 B | 64.505 A | 4.4037 B | 1.3679 B |
| Standard | 7.843 A | 0.234 B | 11.857 A | 49.465 B | 4.578 A | 1.793 A |

Means in a column followed by the same letter are not significantly different at 5% level.

## DISCUSSION

Roodbaraky *et al*. (2012) reported that, the effect of salicylic acid on vase life was significant at 5% probability level, and also was significant on dry matter percent at 1% probability level. Mean comparisons about salicylic acid effect vase life and dry matter percent showed that salicylic acid had the most effective treatment with 12.67 days vase life, and 12.86% dry matter. The effectiveness of this compound can be resulted to water relations improvement, prevent vascular occlusion because of antimicrobial effect, anti-ethylene effect which decreases respiration rate of cut flowers and increased dry matter percent. Nikkhah Bahrami *et al.* (2011) revealed effect of different levels of salicylic acid on vase life of cut Lisianthus (*Eustoma grandiflora*) and reported that 100 mg l-1 of SA improved vase life compared the control. Alaey *et al*. (2011) investigated on effects of salicylic acid pre and postharvest on cut rose and realized that different levels of salicylic acid increased stem fresh and dry weight and also leaf area compared to control. In another study Salicylic acid Bideshki and Arvin (2010) showed salicylic acid affected on increasing root dry weight significantly. Also there are some reports of increasing effects of salicylic acid on, total height, stalk diameter, and dry weight in *Pinus patula* (San-Miguel *et al*., 2003). Increasing the dry weight and height in wheat and black eye pea were caused by salicylic acid (Amin *et al*., 2008).

Amini *et al.* (2013) have reported, the effect of short term treatments (pulsing) with distilled- water or calcium chloride4% +sucrose 3% and permanent hormonal treatments with gibberellic acid, benzyl adenine, and 5-sulphosalicilic acid were effective on the changes of flower diameter between days 0 to 12 (0, 3, 6, 9, 12). Results revealed that benzyl adenine 250ppm in both pulses have the highest effect on preventing the decrease of fresh weight. The lowest fresh weight and diameter belonged to the control.

Wawrzynczak and Goszczynska (2000) improved the length and diameter of carnation cut flower by application of 0.05 and 0.1 mM Kinetin. Kim and Miller (2008) reported that simultaneous using of GA 4+7 and BA causes an increase in diameter of Tulip flowers (Hamidimoghadam *et al*., 2014). Amini *et al*. (2013) showed the highest fresh weights were seen in benzyl adenine 250 ppm in distilled-water pulse and benzyl adenine 250 ppm in calcium chloride+ sucrose pulse. Mutui *et al*. (2004) investigated the response of Benzyladenine on the vase life and the physiological changes in the leaves of Alstroemeria cut flowers in two conducted experiments. Result confirmed that Treatment of Alstroemeria cut flowers with 25 or 50 mg/l benzyle adenine consistently increased the number of days to full opening of primary florets and delayed the start of flower senescence. That is measured by days to 50 % petal fall and 50 % leaf yellowing. However, 75 and 100 mg/l benzyl adenine provided the highest values of leaf dry weight.

## CONCLUSION

Positive impact of plant hormones was detected in most of the studied traits. All studied characteristics include water content, dry weight, vase life, total length, floret length, floret diameter by spraying plant hormones before harvesting. Results of this study revealed that applying of salicylic acid increased vase life cut carnations and increased total length of plants and benzyl adenine lead to all studied traits. In order to the current study it concluded that the spraying benzyl adenine 50 µM was the most effective treatment on all of traits. Due to the increase of use and positive effects on morphological parameters, spraying of benzyl adenine and salicylic acid are one of the best methods in floriculture.

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