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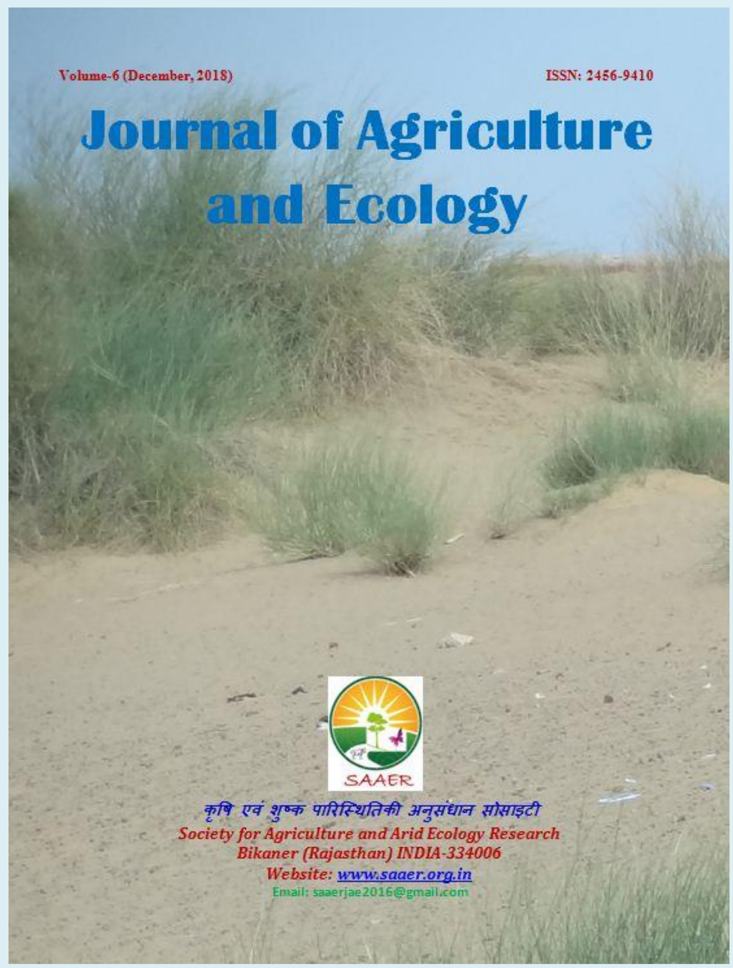

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# Prolonging the shelf life of jasmine (*Jasminum grandiflorum*) buds by chemical treatments under cold storage condition

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**Abstract**

Aim of this study is to enhance the shelf life of jasmine flower buds by application of different anti-senescence chemicals to meet out the marketing demand with improved post-harvest quality. The experimental design followed for this study is completely randomized block design with seven treatments, each replicated thrice. The harvested jasmine flowers were treated with different anti-senescence chemicals *viz*., Silver nanoparticle (SNP) (20ppm), Boric acid (4%), Sucrose (4%), NAA (100 ppm), BA (500 ppm), α-AIB (20μM) and packed in 200 gauge polypropylene bag without ventilation then stored in cold storage condition. Among the different anti-senescence chemical treatments silver nanoparticle (20 ppm) shows positive significant difference in freshness index, flower opening index, color retention index and maintained the shelf life up to 11 days over the control for 7 days.



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## Introduction

Among different jasmine species *Jasminum grandiflorum* is one of most important and remunerative crop for loose flower production and oil extraction purpose. This species flowers had the high demand in market throughout the year. The jasmine crop is cultivated in the open fields since ancient period for its peculiar and delicate fragrance and also for its aromatic and medicinal value. *J. grandiflorum* is a native of India and popularly called 'Royal Spanish', 'Catalonian', or Italian Jasmine. The leaves are shining dark green with 5-7 leaflets. This is twining shrub with pendulous branches. Flowers are white with a purplish tinge underneath and highly scented. Varieties coming under this are pink pin, CO-1, pitchi, thimmapuram, Lucknow *etc. J. grandiflorum* is grown for extraction of perfume. Jasmine flowers owe their fragrance to a volatile oil present in the epidermal cells of the inner and outer surface of the petals and sepals. The international market prices for jasmine concrete and absolute are around Rs. 12000/kg and Rs. 19000/kg respectively. Extraction of oil from jasmine is yet to be exploited to its fullest potential in India. Among the scented species, *J. angustifolium, J. officinale, J. humile, and J. pubescens* were useful. The Indian *J. grandiflorum* have more importance compared with that of Spanish jasmine, both in yield and quality of oil. The jasmine cultivated area is about 8000 ha in India with 56.57 MT flower production (www.indiastat.com, 2014-2015). But the post harvest loss is about nearly 20%. It leads to huge loss to farmers as well as retailers and result is fluctuation in market demand. To meet out this market demand we are in place to improve the post harvest quality of these flower buds to extend the shelf life. Hence, the present study entitled "Prolonging the Shelf life of jasmine (*Jasminum grandiflorum*) buds by chemical treatments under cold storage condition" was carried out to improve the shelf life of *Jasminum grandiflorum*.

## Materials and methods

The present research investigation entitled "Prolonging the Shelf life of jasmine (*Jasminum grandiflorum*) buds by chemical treatments under cold storage condition" was carried out in the Department of Crop Physiology, Agricultural College & Research Institute, TNAU, Coimbatore during the year 2017-2018. The experiment design followed for this study is completely randomized block design and each treatment replicated thrice. The treatments comprised of six anti-senescence chemicals *viz*., Silver Nano Particle (20 ppm), Boric acid (4%), Sucrose (4%), NAA (100 ppm), BA (500 ppm), α-AIB (20µM) and control. The flowers were harvested at morning time between 6.30 AM to 7.30 AM. These flower buds are then immersed in chemical solution by quick dipping method and surface drying was done. Later, they were packed in 200 gauge polypropylene bag with no ventilation for storage under in cold room condition with 7-8$^{o}$C and 85 – 95% RH. Visual observations were recorded as sensory evaluation scoring based on Madhu (1999).

## Freshness index

The number of flowers which retained freshness without exhibiting petal necrosis, wilting and browning was measured by visual observation using the following score expressed as per cent fresh flowers or freshness index.

| Condition of flowers | Score | Number of flower buds under this score |
|---|---|---|
| Almost all buds turgid | 7 | $X_1$ |
| Partial to half open flowers, turgid | 6 | $X_2$ |

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| | | |
|---|---|---|
| Half to full open flowers, turgid | 5 | $X_3$ |
| Partial to half open flowers, slightly wilted | 4 | $X_4$ |
| Half to full open flowers, slightly wilted | 3 | $X_5$ |
| Partial to half open flowers, fully wilted | 2 | $X_6$ |
| Half to full open flowers fully wilted | 1 | $X_7$ |

Freshness index (FI) was computed using the following formula:

$$FI=\frac{(7\times X_1)+(6\times X_2)+(5\times X_3)+(4\times X_4)+(3\times X_5)+(2\times X_6)+(1\times X_7)}{(X_1+X_2+X_3+X_4+X_5+X_6+X_7)\times 7}\times 100$$

**Flower opening index**

The flower opening index was measured by the following score.

| Stage of flowers | Score | Number of flower buds under this score |
|---|---|---|
| Unopened buds | 0 | $X_1$ |
| Slightly opened | 1 | $X_2$ |
| Half opened | 2 | $X_3$ |
| Full opened | 3 | $X_4$ |

Flower opening index (FOI) was computed using the following formula,

$$FOI=\frac{(0\times X_1)+(1\times X_2)+(2\times X_3)+(3\times X_4)}{(X_1+X_2+X_3+X_4)\times 3}\times 100$$

**Color retention index**

The retention of white colour of jasmine flowers was recorded by the following score

| Flower colour development during storage | Score | Number of flower buds under this score |
|---|---|---|
| Bright pink with white | 9 | $X_1$ |
| Dull pinkish white | 8 | $X_2$ |
| Cream or yellowish | 7 | $X_3$ |
| 1 to 10% brown | 6 | $X_4$ |
| 11 to 15% brown | 5 | $X_5$ |
| 16 to 50% brown | 4 | $X_6$ |

| | | |
|---|---|---|
| 51 to 75% brown | 3 | $X_7$ |
| 76 to 90% brown | 2 | $X_8$ |
| All brown | 1 | $X_9$ |

Colour retention index (CRI) was computed by using the following formula:

$$CRI = \frac{(9\times X_1)+(8\times X_2)+(7\times X_3)+(6\times X_4)+(5\times X_5)+(4\times X_6)+(3\times X_7)+(2\times X_8)+(1\times X_9)}{(X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9)\times 9} \times 100$$

**Shelf life**

Shelf life of flowers was assessed by recording the number of days up to which 50 per cent or more flowers kept fresh (50% of Freshness index score). The time taken for the development of necrotic symptoms was recorded and the shelf life was determined as the number of days taken from placing of the loose flowers till wilting and fading of petals of these loose flowers Madhu (1999).

**Statistical analysis**

Statistical analysis for the CRD *viz*., computation of mean, standard error and critical difference was carried out using Excel and SPSS 9.4 packages. The required graphs were drawn using MS Excel software packages. The per cent values were first transformed to angular arcsine values before the analysis wherever it necessary. The data were tested for at five per cent level (*)for significance and non significant (NS). Wherever the treatment differences were found significant (‘F’ test) critical differences were worked out at five per cent probability level and the values furnished. Differences between the treatments were determined using Duncan’s test.

**Results and Discussion**

**Freshness index**

Result on FI of *J. grandiflorum* shows that under cold storage condition flower buds treated with SNP 20 ppm ($T_2$) has registered maximum FI with 94.19% followed by AIB (20µM) ($T_7$) with 93.36% FI over the control ($T_1$) (86.76%). Freshness index varied among the treatments, storage condition and jasmine species (Table 1). Maximum freshness index recorded by best treatments may be the effect of packaging material that reduce the rate of respiration by creating a sort of modified atmosphere with limited oxygen and higher carbon dioxide concentrations. The limited oxygen concentration can retard the rate of respiration as oxygen is an essential factor needed for this process. The findings of Beura & Singh (2003) supported the results of the present experiment with a view that minimum weight loss, more freshness and higher membrane stability index in gladiolus cultivars might be due to reduction of respiration with limited oxygen and higher carbon dioxide concentration. These findings also have close agreement with the observations recorded by in gladiolus cultivars and found minimum weight loss, more freshness and good membrane stability index.

**Table 1.** Effect of different anti-senescence chemical treatment and cold storage condition on freshness index of *Jasminum grandiflorum*

| Treatments | 1DAT | 3 DAT | 5 DAT | 7 DAT | 9 DAT | 11 DAT | Mean |
|---|---|---|---|---|---|---|---|
| $T_1$ -Control | 97.14 | 96.57 | 88.57 | 85.14 | 87.42 | 65.71 | 86.76 |
| $T_2$ | 100.00 | 96.57 | 96.57 | 94.28 | 90.85 | 86.85 | 94.19 |
| $T_3$ | 93.14 | 98.28 | 96.00 | 96.00 | 84.00 | 70.85 | 89.71 |
| $T_4$ | 99.42 | 91.42 | 90.85 | 85.71 | 84.00 | 60.57 | 85.33 |
| $T_5$ | 96.00 | 86.85 | 74.28 | 72.00 | 70.85 | 64.57 | 77.43 |
| $T_6$ | 99.42 | 96.57 | 96.00 | 87.42 | 77.14 | 68.00 | 87.43 |
| $T_7$ | 99.42 | 98.28 | 97.71 | 97.14 | 86.85 | 80.76 | 93.36 |
| Mean | 97.79 | 94.93 | 91.43 | 88.24 | 83.02 | 71.04 | 87.74 |
| S. Ed. | NS | 2.34 | 1.17 | 2.38 | 2.12 | 1.15 | |
| CD (5%) | NS | 5.01* | 2.51* | 5.10* | 4.55* | 2.46* | |

DAT- day after treatment
*Significant at 5% probability level

**Flower opening index**

Minimum FOI (13.09%) was recorded by SNP 20 ppm ($T_2$) followed by AIB (20µM) ($T_7$) with 14.04 % after 11 days of treatment under cold storage condition over the control. Flower opening index was found to be significantly influenced by MAP in the present study. Both under ambient and cold room conditions, least FOI were registered by SNP in *J. grandiflorum* (Table 2). Some of the earlier conclusions drawn about flower opening in cut roses have been shown to be dependent on carbohydrate status in the petals (Kenis *et al.*,1985). Petal growth associated with flower bud opening results from cell expansion, which requires the influx of water and carbohydrates into petal cells (Reid 1988). According to Vandoorn & Witte (1991) who found that reduced water status of flowers is known to record the lowest flower opening under ambient conditions while in MAP low level of $O_2$ in the packages would record least FOI (Devecchi et al. 2003).

**Table 2.** Effect of different anti-senescence chemical treatment and cold storage condition on flower opening index of *Jasminum grandiflorum*

| Treatments | 1 DAT | 3 DAT | 5 DAT | 7 DAT | 9 DAT | 11 DAT | Mean |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $T_1$ -Control | 6.60 | 8.00 | 26.60 | 34.66 | 41.33 | 65.33 | 30.42 |
| $T_2$ | 0.00 | 8.00 | 9.30 | 9.30 | 21.33 | 30.60 | 13.09 |
| $T_3$ | 2.60 | 16.00 | 17.30 | 17.30 | 24.00 | 30.60 | 17.97 |
| $T_4$ | 1.30 | 8.00 | 20.00 | 21.30 | 38.60 | 49.30 | 23.08 |
| T5 | 9.30 | 30.60 | 65.33 | 65.33 | 69.33 | 77.33 | 52.87 |
| $T_6$ | 1.30 | 8.00 | 65.33 | 65.33 | 69.30 | 77.33 | 47.77 |
| $T_7$ | 0.00 | 4.00 | 5.30 | 9.30 | 28.00 | 37.66 | 14.04 |
| Mean | 3.01 | 11.8 | 29.88 | 31.79 | 41.70 | 52.59 | 28.46 |
| S. Ed. | 0.03 | 0.29 | 0.26 | 0.79 | 0.75 | 1.69 | |
| CD (5%) | 0.07* | 0.62* | 0.55* | 1.69* | 1.60* | 3.63* | |

DAT- day after treatment
*Significant at 5% probability level

**Color retention index**

Maximum CRI (98.66%) was observed in SNP 20 ppm ($T_2$) and AIB (20µM) ($T_7$) in *J.grandiflorum*. They were on par with each other after 11 days of treatment when stored in cold storage condition. The color retention index was also significantly influenced by treatments and storage conditions. Under cold storage condition SNP in *J.grandiflorum* registered maximum color retention index. However none of the treatment recorded less than 50 per cent color retention index under cold storage condition but it declined from 100 to 75 per cent (3 to 11 days) in *J. grandiflorum* (Table 3). The yellowing of florets during modified atmospheric packing storage has been reported due to the losses of membrane integrity, protein and chlorophyll caused by lipid peroxidation and hydroperoxides in broccoli was also observed by Watada *et al.* (1990). Color retention of the flowers could be related to the activity of polyphenol oxidase and its action on phenolic content in flowers. Increasing phenolic compounds during later stages causes the browning of flowers where in color retention index is low. In the present study, 100 per cent color retention index was associated with the least activity of phenol compound under cold storage condition. In case of ambient storage condition also, the maximum color retention index was associated with the lowest phenol content. This explains that enzymatic discoloration is caused by the oxidation of phenol compounds due the action of polyphenol oxidase which leads to the browning in plants during wilting (Lee & Whitaker, 1995). Tian et al. (2002), demonstrated the positive effect of modified atmospheric storage reduces the activity of polyphenol oxidase and ethylene production. But also MAP package delay the development of browning in flowers it has been attributed to $CO_2$ inhibition activity on the enzyme polyphenol oxidase. Day (1996), explained the significant role of modified atmospheric storage due to high level of $CO_2$ or of colorless quinines may inhibit polyphenol oxidase, resulting in the inhibition of enzymatic discolouration in MAP.

**Table 3.** Effect of different anti senescence chemical treatment and cold storage condition on colour retention index of *Jasminum grandiflorum*

| Treatments | 1 DAT | 3 DAT | 5 DAT | 7 DAT | 9 DAT | 11DAT | Mean |
|---|---|---|---|---|---|---|---|
| $T_1$-Control | 100.00 | 98.22 | 96.00 | 91.11 | 89.33 | 81.33 | 92.67 |
| $T_2$ | 100.00 | 100.00 | 100.00 | 98.22 | 96.88 | 96.88 | 98.66 |
| $T_3$ | 100.00 | 99.55 | 99.11 | 96.11 | 94.77 | 89.33 | 96.48 |
| $T_4$ | 100.00 | 99.55 | 99.11 | 99.11 | 93.77 | 67.55 | 93.18 |
| $T_5$ | 99.55 | 97.33 | 80.00 | 80.00 | 79.11 | 75.55 | 85.26 |
| $T_6$ | 100.00 | 99.55 | 99.11 | 98.66 | 91.55 | 76.44 | 94.22 |
| $T_7$ | 100.00 | 100.00 | 100.00 | 99.55 | 92.00 | 88.00 | 96.59 |
| Mean | 99.94 | 99.17 | 96.19 | 94.68 | 91.06 | 82.15 | 93.87 |
| S. Ed. | NS | 2.36 | 2.52 | 1.33 | 2.97 | 1.26 | |
| CD (5%) | NS | 5.07* | 5.42* | 2.86* | 6.38* | 2.70* | |

DAT- day after treatment
*Significant at 5% probability level

**Shelf life**

In *J. grandiflorum* the treatment of SNP 20 ppm ($T_2$) was significant and recorded maximum shelf life of 11 days under cold storage condition. AIB 20µM ($T_7$) also found to be significant on shelf life enhancement over the control ($T_1$) 7 days and on par with each other. It could be observed in the present study that shelf life (days) was significantly affected by all the treatments and storage conditions. Flower buds of *Jasminum grandiflorum* treated with silver nanoparticle (20 ppm) stored in cold storage registered the maximum shelf life of 11days and this treatment is significantly superior over the other treatments and control (7 days). The present finding is in accordance with the results of Madaiah & Reddy (1994) in *J. multiflorum* and *Polianthes tuberosa*. Further, similar observation was made by Thamaraiselvi et al. (2010) in *J. sambac*, *J. grandiflorum*, *Polianthes tuberosa* who reported that flowers stored in cold storage condition registered maximum shelf life compared to ambient storage condition. Similar to this findings Nirmala & Reddy (1993) was also observed significant increase in shelf life due to packaging and storage conditions in jasmine. Nagaraja et al. (1999), also revealed the similar effect of packaging and storage in tuberose and reported that an enhanced shelf life under cold storage condition. Jawaharlal et al.(2012), further explained that increase in shelf life under cold storage condition in jasmine. These findings strongly supported the results of the present study.

## Conclusion

This study concluded that flower bud stored in cold storage condition with post harvest anti senescence chemical (SNP 20 ppm) treatment has registered highest shelf life by the way of maintained higher freshness index, flower opening index and color retention index. During peak flowering season farmers facing long term storage problem due to its short shelf life of this flower nature. The present study reduces this constraint.

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