Biological Forum – An International Journal **14(4): 601-606(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Nano Silver, Nano Silica and Dextrose on Extending the Vaselife of Cut Roses

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(Received 14 September 2022, Accepted 21 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Rose is a principal cut flower in the world trade. Post-storage characteristic is one of the most crucial research problem of a cut rose flower, as they have a limited vase life due to xylem channel blockage and insufficient water absorption. Bacteria obstruct xylem vessels in the stem, which decreases the rate of water supply to flowers. The main aim of the study is to identify and standardize the hydration treatments to extend the vase life of shelf of cut roses. It was investigated whether nano-silver and nano-silicon particles could extend the vase life of cut rose flowers. Under carefully regulated circumstances, cut flowers were stored in vases holding various compositions of 5, 20, and 50 ppm of nano-silver, nano-silica, and dextrose solution treatments. Vase life, colour, form, texture, and appearance were all measured throughout this time. From the results it was found that nano silica reduced lipid peroxidation and stimulated antioxidant enzymes, while nano silver had antibacterial properties at low concentrations. In comparison to STS and silica, the results showed that modest concentrations of nano-silver and nano-silica treatments increased the lifetime of cut flowers. NHT9 gave good results compared to NHT14. The combination of dextrose, silica nano-particles, determined that nano silica particles stimulated the antioxidant enzymes and nano silver particles had a great capability for removing bacterial pollutants. These results implied that to enhance the overall quality and extend the vase life of cut roses, post harvest requires the application of solutions (NHT9- Nano Silver 5 ppm (10 ml) + Dextrose (2 gms) containing nano-silver and nano-silica (mostly nano silver) particles and dextrose.

Keywords: Nano-silver particles, Nano-silica particles, Dextrose, Colour, Form, Texture, Appearance and Vase life.

INTRODUCTION

Rose flowers are labelled as either cut flowers or potted plants. Cut rose flowers often have a short vase life. The floral axis of these cut flowers wilts and bends slightly below the flower's head (bent neck). A key element affecting the quality and lifespan of cut flowers is water balance. Being the equilibrium of these two processes, water intake and transpiration have an impact on it. Water loss and water uptake from cut flowers are thought to be out of balance for a number of reasons, including stem end blockage. Delay in wilting is caused by the vase solution's prevention of microbial growth in many cut flowers. To improve water uptake and prolong vase life for cut flowers, a variety of chemicals have been added to vase solutions. Because there is a limited supply of carbon in cut flowers, the sugar concentration is another element affecting vase life. Typically, sucrose and other sugars were added to vase water to prolong the vase life of cut roses. $AgNO_3$ is no longer used in commercial vase solutions due to the damage it poses to human health and the environment (Niguel, 2002). It is crucial to create a new material as a substitute for these compounds for the floriculture sector.

Nair *et al.* (2010) mentioned that nanoparticles have recently been used in agriculture. But the plant cell wall serves as a deterrent, preventing simple entry of outside factors into the plant cells. Nano-particles can easily pass through cell wall pores since they are smaller than those structures. Through the stomata or base of trichomes on the leaf surface, nano-particles enter the plant and go to various tissues.

Hassan *et al.* (2014) explained that silver nano-particles (SNPs) are new compounds that are widely used for their antimicrobial properties, high electrical and thermal conductivity, non-linear optical behaviour, catalytic activity, and chemical stability with the rapid increase in the use of nanotechnology.

According to Seglie *et al*. (2012), pulse treatment with a 5 mg L-1SNP solution for 24 hours increased the vase life of cut gerbera cv. Ruikou flowers. Additionally, they showed that the beneficial effects of SNP were caused by bacterial growth being inhibited in the vase solution and at the cut stems' ends.

Joyce *et al*. (2016) enlighted that compounds containing silver typically increased the vase life of cut roses. In order to increase the vase life of cut rose flowers, our present study compared the bactericidal effects of SNP and NSi. In order to increase the longevity and bloom quality of cut rose blossoms, I had examined the effects of SNP and NSi followed by dextrose.

Varun *et al*. (2017) mentioned that it is very new to use silver nanoparticles (SNP) and silica nanoparticles to hydrate cut flowers, but they have already proven valuable as antibacterial agents that can eradicate 650 different species of bacteria in water. SNP causes the release of the silver ions Ag+ (16), which take the place of the hydrogen cation (H+) of the sulfhydryl or thiol groups (-SH) on surface proteins in bacterial cell membranes, reducing membrane permeability and ultimately leading to cell death.

According to Kamiab *et al.* (2017), lisianthus cut flowers treated with 40 mg L-1 of nano silver and 40 mg L-1 of nano silica particles had a 17-day shelf life extension when compared to control flowers. The treated flowers also had larger relative fresh weights, solution uptake, total chlorophyll, and total dissolved solids, especially at higher doses. Application of either nanoparticle (Silver or Silicon) at 40 mg L-1 did not result in microbial proliferations, hence this concentration was regarded as the most effective level for both nano-particles.

According to Ruffo *et al*. (2019), nanotechnology also contributes to extending the postharvest life of many horticultural products in various ways to reduce horticultural product waste (20-30%), such as the creation of new innovative packaging materials (nanocomposites), controlling postharvest diseases, shielding stored products from the influence of harmful rays and gases, using multiple chips (biosensors) for labelling fresh produce, and improving strength and applicability.

Naing and Kim (2020) explained that one nano-particle has a high electric charge and lacks two electrons in its shell, which attracts pathogenic microbes. The microbes are harmed and subsequently destroyed by nano-particles, which also enhance floral quality and lengthen the vase life of the flowers by capturing

This study's objective was to analyse the impact of silver nano-particles, silica nano-particles, and dextrose with the conventional method of employing silver thiosulphate, silica, and dextrose as sources to prolong vase life and maintain cut roses' postharvest quality.

MATERIALS AND METHODS

The study's experimental research design was used to carry it out. Seasonal roses in the colour red were chosen. Hydration treatments were discovered to be important to increase the vase life of cut flowers. In order to determine the best hydration preservative for extending the vase life of cut roses, experiments were carried out at Professor Jayashankar Telangana State Agriculture University, College of Community Science, Department of Resource Management and Community Science, Hyderabad, Telangana from February 2021 to April 2021. In this investigation, fifteen nano treatments were tried on the flower both separately and in combination. Fifteen nano hydration chemical preservative solutions were used for vase life analysis and these were NHT0: Distilled water (control)., NHT1: Silver thiosuphate (10ml) + Nano Silver 20 ppm (10ml)., NHT2: Silica (2gms) + Nano Silver 20 ppm (10 ml)., NHT3: Silver thiosuphate (10ml) + Nano Silica 20 ppm (10ml), NHT4: Silica (2gms) + Nano Silica 20 ppm (10 ml)., NHT5: Nano Silver 20ppm (20 ml)., NHT6: Nano Silica 20 ppm (20 ml)., NHT7: Nano Silver 50 ppm (10 ml) + Dextrose (2 gms)., NHT8: Nano Silver 20 ppm (10 ml) + Dextrose (2 gms)., NHT9: Nano Silver 5 ppm (10 ml) + Dextrose (2 gms)., NHT10: Nano Silica 50 ppm (10ml) + Dextrose (2 gms)., NHT11: Nano Silica 20 ppm (10ml) + Dextrose (2 gms)., NHT12 : Nano Silica 5 ppm (10ml) + Dextrose (2 gms)., NHT13: Nano Silver 5ppm (10 ml) + Nano Silica 5ppm (10ml)., and NHT14: Nano Silver 5ppm (10 ml) + Nano Silica 5ppm (10ml) + Dextrose (2gms). Data on vase life as well as on the elements of colour, form, texture, and appearance were gathered. An observation tool (rating scale) created by Reddy and Kumari (2010) and Sireesha (2012) was utilised to observe qualitative aspects physically. An expert panel of judges who have experience rating the qualities of flowers conducted observations. The colour, texture, form, and look were the parameters considered for evaluation on the rating scale.

RESULTS AND DISCUSSION

This section of the study discusses the suitability of nanohydration treatments, specifically the combinations of dextrose, nanosilver, and various concentrations of nanosilver. The roses had 14 different hydration treatments employing nano compounds at various concentrations, and Table 1 shows the physical observation ratings. No of the treatments, it can be shown from the data observations that flowers stayed fresh for a sixth day without changing in terms of their physical characteristics.

Results shown in Table 1 showed how nanohydration treatments affected roses. Fig. 1 illustrates how flowers' ability to maintain their freshness with nano treatments varied noticeably. All flowers were discovered to be fresh between seven and eight days, and beginning on the ninth day, the quality of the blooms in NHT4, NHT6, and NHT10 gradually declined. Flowers given the NHT9 and NHT14 treatments kept their freshness up until day 14, after which there was a slight alteration. This observation suggests that roses treated with nanochemicals, primarily silver, produced positive results. According to Kamiab *et al*. (2017) and Kader *et al*. (2017), lesser concentrations of nano silver with the addition of nano silica and dextrose had a good impact on floral quality when compared to other concentrations.

However, the maximum evaluation was observed from NHT9 and NHT14 with lowest silver concentration following with combination of lower concentrations of nano silver and nano silica together with dextrose. Both nano silver and nano silicon application boosted cut rose flowers longevity. Sucrose and NS applications both lengthened the life of cut flowers, however treatment with NHT9 produced the longest-lasting flowers. The vase life of cut flowers was found to be prolonged by the application of nano silver and sucrose by Solgi *et al*. (2009) in flower hybrid Limonium, Basiri *et al*. (2011) in cut rose flower rose, Moroones *et al*. (2011) in cut rose flower rose, and Kazemi and Ameri (2013) in experiments on gerbera cut flowers. The results of these tests generally concur with those found in other investigations. Additionally, according to the results that were observed, Liu *et al*. (2009) in rose cut flower, Basiri *et al*. (2011) in carnation, stated that the use of nano-silver lengthened vase life (Table 1).

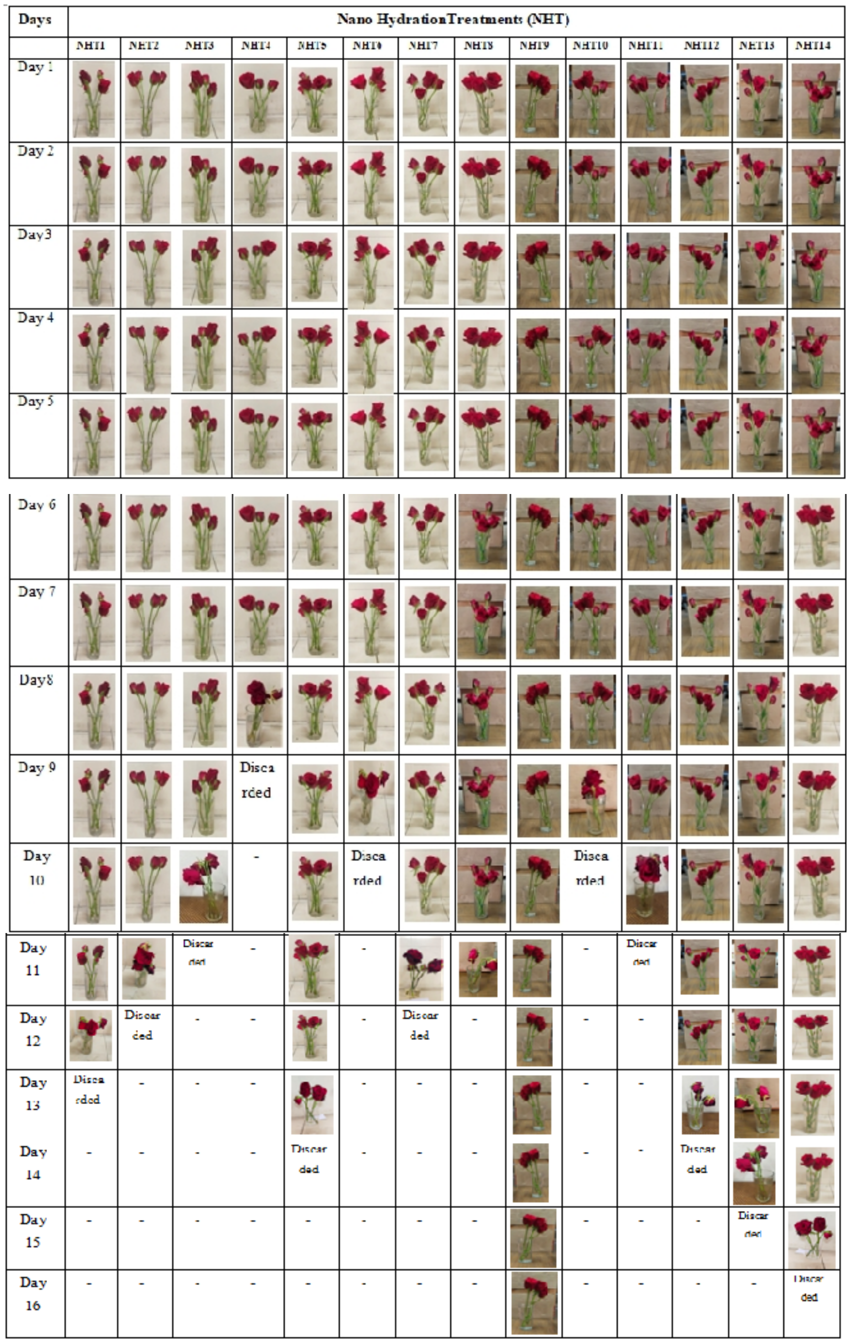

Fig. 1. Effect of Nano Hydration Treatments on Roses.

Table 1. Effect of Hydration Treatments on Physical Observation Scores of Roses with Nano Chemicals.

Days/Treatments	NHT0	NHT1	NHT2	NHT3	NHT4	NHT5	NHT6	NHT7	NHT8	NHT9	NHT10	NHT11	NHT12	NHT13	NHT14
Day 1	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Day 2	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Day 3	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Day 4	7	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Day 5	3	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Day 6	3	11	10	9	11	11	10	11	11	11	11	10	11	11	11
Day 7	-	11	10	9	10	11	10	11	11	11	10	9	11	11	11
Day 8	-	9	10	9	8	10	8	10	10	11	10	9	10	11	11
Day 9	-	9	9	7	-	10	8	10	10	11	8	8	10	10	11
Day 10	-	6	9	6	-	10	-	8	8	11	-	7	10	10	11
Day 11	-	6	8	-	-	8	-	6	8	11	-	-	10	10	10
Day 12	-	5	-	-	-	8	-	-	-	10	-	-	8	9	10
Day 13	-	-	-	-	-	-	-	-	-	10	-	-	6	9	10
Day 14	-	-	-	-	-	-	-	-	-	10	-	-	-	7	8
Day 15	-	-	-	-	-	-	-	-	-	8	-	-	-	-	8
Day 16	-	-	-	-	-	-	-	-	-	8	-	-	-	-	6

*NHT – Nano Hydration Treatment

Fig. 1 qualitative parameters for nano-hydrated cut flowers showed that NHT9 and NHT14, in that order, had the highest scores for colour, form, texture, and appearance. NHT13 came in third. The score values increased with the addition of nano silver, nano silica, and dextrose (NHT9). This part of the study demonstrated how the quality of cut flowers might be improved by adding specific preservatives, particularly nano silver and nano silica at varied concentrations. These tests' findings generally concur with those of research by Lu *et al*. (2010) on the rose cut flower variety "Movie Star" and Kazemi and Amiri (2013), who found that adding nanosilver to cut flowers lengthened their vase life.

Colour: According to the findings, the majority of the treatments showed little to no colour change. Low concentrations of nano silver preserved colour quality due to improved hydraulic conductance, however high concentrations of nano silver and dextrose caused colour shift.

Form: The size and shape of the blooms changed dramatically with varied combinations and concentrations, and NHT9, NHT14, and NHT13 were determined to be the most effective treatments when compared to the other treatments. This reveals that chemical mixtures in different ratios significantly affected the quality of the bloom. Additionally, nano silver stops microbes from producing ethylene, poisonous chemicals, and enzymes that quicken ageing (Williamson *et al*., 2002).

Texture: In mixed concentrations, there was a noticeable change in the texture of the flowers, and NHT9 and NHT14 performed best while the texture of the other flowers was lost. This observation demonstrates how adding nano silver and small amounts of nano silica to the hydration process helped the cut flowers maintain their texture. According to Moradi *et al*. (2012) in Dianthus cv. "Cream Viana," application of the mixture of sucrose and nano silver further extended the vase life and preserved the natural texture of cut flowers, which was consistent with the aforementioned findings.

Appearance: NHT9 and NHT14 performed better in terms of colour, form, texture, and appearance scores compared to the natural appearance of rose colour, which is smooth and glossy. According to Moadab *et al.* (2011), high scores for NHT14 in terms of colour, form, and texture also contributed to high scores for appearance because these criteria are interdependent on one another.

Table 2: F test and t-Test of Physical Observation Score of Roses using Nano Hydration Treatments.

F-Test Two-Sample for Variances		
	Day 8	*Day 9*
Mean	8.462	9.277852
Variance	2.221112	10.685862
Observations	14	14
df	7	7
F	0.46536	
P(F<=f) one- tail	0.015828	
F Critical one-tail	0.265896	

t-Test: Paired Two Sample for Means		
Day 9	*NHT4*	*NHT9*
Mean	4.1	6.2
Variance	3.666	4.6
Observations	16	16
Pearson Correlation	0.385821	
Hypothesized Mean Difference	0	
df	7	
t Stat	-3.284632	
P(T<=t) one-tail	1.95842	
t Critical one-tail	1.842361	
P(T<=t) two-tail	2.74201	
t Critical two-tail	2.492453	

These results were statistically analysed to see how treatments affected the amount of days it took to maintain the attributes of the blooms shown in Table 2. The results showed that cut rose flowers held their freshness well up to the ninth day and began to drastically decline after that, but NHT9 flowers remained fresh (Ruffo *et al*., 2019) for up to 16 days (F-Test Two- Sample for Variance). Treatment NHT9 was discovered to significantly differ from other treatments (t-Test: Paired Two Sample for Means) for a 16-day period, followed by NHT14 (15 days). In order to administer water soluble chemical inhibitors of ethylene action and postpone the senescence of cut flowers, nanohydration treatments with low concentrations (NHT9 - Nano Silver 5 ppm (10 ml) + Dextrose 2gms and NHT14 - Nano Silver 5 ppm (10 ml) + Nano Silica 5 ppm 10ml + Dextrose 2gms) are used (Koohkan *et al.,* 2014).

CONCLUSION

The vase life of cut rose flowers was greatly increased by utilising nano hydration treatment with 5 ppm concentration of SNP and low concentration NSi, combined with the suppression of microbial development at stem ends. Silver ions move very slowly through the stems of rose blooms. Application of a nanoparticle with antibacterial properties can therefore increase the pace of that and lengthen the longevity of cut flowers. Although nano silica has an impact on vase life and sustaining floral quality along with SNP, its application must be applied quickly to extend the life of cut flowers. Therefore, using SNP (33 nm in diameter) instead of other silver compounds, along with 5% sucrose and 5 ppm of nano silica, is advised to prolong the vase life of cut roses.

FUTURE SCOPE

Other nano-particles with antimicrobial properties may be used to increase cut flower mobility, extend their shelf life and enhance overall quality of cut roses and also other flowers.

Acknowledgement. I would like to express my heartfelt gratitude to my chairperson and the members of my advisory committee for providing me with excellent guidance throughout my studies.
Conflict of Interest. None.

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How to cite this article: P. Rajya Lakshmi, D. Ratna Kumari, V. Vijaya Lakshmi, R. Neela Rani and A. Meena (2022). Effect of Nano Silver, Nano Silica and Dextrose on Extending the Vaselife of Cut Roses. *Biological Forum – An International Journal, 14*(4): 601-606.