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Effect of postharvest preservatives on vase life of cut rose (*Rosa hybrida* L.) cv. top secret

Shiwani Kshirsagar, Anuj Kumar, Om Singh, Roshan Gallani and Reena Parmar

Abstract
The research experiment was laid out in completely randomized design with three replication and fourteen treatments like Control, Sucrose (2.0%), Silver Nitrate (30 ppm), Silver Nitrate (60 ppm), Boric Acid (75mg/l of water), Boric Acid (100mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm), Sucrose (2.0%) + Silver Nitrate (60 ppm), Sucrose (2.0%) + Boric Acid (75mg/l of water), Sucrose (2.0%)+ Boric Acid (100mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm) +Boric Acid (75mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm) + Boric Acid (100mg/l of water),Sucrose (2.0%) + Silver Nitrate (60 ppm) + Boric Acid (75mg/l of water), Sucrose (2.0%)+ Silver Nitrate (60 ppm) + Boric Acid (100mg/l of water) were used for experiment. Data revealed that the treatment T_{11} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water) recorded the best performance with respect of days taken to 1st petal spreading, change in weight of flowers at senescence, flower freshness score, maximum flower head diameter, petal discoloration score, change in TSS, change in chlorophyll content, change in anthocyanin content and vase life.

Keywords: $AgNo_3$, boric acid, ppm

Introduction
The rose (*Rosa hybrida* L.) is a woody perennial flowering plant and most popular flower of all gardens throughout the world. It is an indication of love, perfection, elegance and romance. It was called "The Queen of Flowers" firstly by Greek poetess in her "Ode to the Rose" (Muhummad *et al*., 1996) [18]. Rose is belonging to family Rosaceae and genus Rosa. A numbers of species are found in the northern temperate climate zone, tropical and subtropical parts of the world (Zlesak, 2006) [28]. It is hard to imagine a garden without roses (Farahat *et al.*, 2014) [6]. Apart from being admired for its beauty, rose is used in worship, garlands, bouquets, cut flowers preservers and decorations etc. because of variation in growth habit, shape, size, form, colour, fragrance and so many varieties, rose have wide suitability. Roses are acknowledged extremely beneficial for economical benefits being the good source of unprocessed material for cosmetics, perfumery and other agro-based industries. Gulkand is a value added product of rose petals used as a good digestive tonic and blood purifiers. Fruits are applied on wound, sprain, injuries and foul ulcer. Rose hips are used to make rose syrup which is rich in vitamin 'C' and used for different purpose.

It secures 1st position in world floriculture trade. Rose is one of the important cut flower, which have great demand in the national as well as international market. Major rose growing countries are France, Spain, USA, Italy, South Africa, and India. Rose is one of the potentially valuable cut flower and is an important commercial flower crop of our country. In India cut roses are grown in different parts of the country in which, Karnataka and Maharastra are major rose growing state of the country followed by Tamil Nadu, West Bengal and Himachal Pradesh.

Post-harvest life is an important criteria for evaluation of cut flower quality, for both domestic and international markets. It has been established that the post-harvest behavior of rose is an outcome of the physiological processes occurring in the leaves, stem, flower bud, the leafless peduncle connecting the bud to the stem and other related thing. Mineral nutrition, foliar feeding, irrigation and growth regulator sprays were found to influence vase life and post-harvest quality of cut rose. Vase life is the period during which cut flower or cut foliage maintain its appearance in a vase. Vase life refers to the duration of time cut flowers retains their appearance and aesthetic value, especially when sitting vase water.

The vase life of cut flower with its keeping quality is most important and economic for rose growing farmers. Improvement of the keeping quality and enhancement of vase life of cut rose is an important area of research.

Although various techniques have been developed to extend the vase life, however, there is a need to develop a simple method, which may be followed right at the producer end.

Vase life of cut rose is depends on different factors like air, water, and microorganisms like bacteria, fungus etc. Stem end blockage and the imbalance between water uptake and water loss from cut flowers are another factors which affects vase life of cut roses. Water balance is a factor determining quality and longevity of cut flowers. Vase life of cut rose flowers is usually short, and it related to wilting, ethylene production and vascular blockage by air and microorganisms (Elgimabi, 2011) [5].

The senescence is the last stage of development processes that lead to death of flower, the reason behind this phenomenon is the reduction of energy during growth and development (Figueroa *et al*., 2005) [8]. It seems that supply of exogenous carbohydrate should be sufficient to delay the vase life (Kaltaler & Steponkus, 1976) [12] and supply a cellular respiration (Cho *et al*., 2001). The vase life of flowers a large number of preservatives are available in the market in which sucrose, $AgNo_3$ and Boric acid are important chemical preservatives, which are mostly used to enhance the vase life of different flower crops. Addition of different preservative solution is recommended to enhance the vase life of cut flowers (Ichimura *et al*., 2006) [11].

In flower, respiration is an important process for growth and flowering, in which sugar plays key role for respiration, growth and supply all essential components to flower buds (Sarkka 2005) [21]. Sugars are good source of food that provides carbohydrates energy to flower stem to regulate the metabolic process. The counter effect of defoliation in petal colour and bud blasting can be overcome by addition of sugars in form of sucrose. Carbohydrate is a major source of food and energy, reduction of carbohydrates may be resulted in form of vase life reduction of cut flowers.

Silver salts like, Silver nitrate ($AgNO_3$) is an important floral preservatives and act as ethylene inhibitor and as a germicide for extending vase life (Singh and Tiwari, 2002) [25].

Boric acid is another compound which delays senescence on vase life of cut flowers (Serrano *et al.,* 2001) [22]. It inhibits ethylene production through reducing ACC synthase and ACC oxidase activities (Serrano *et al.,* 2001) [22].

Materials and Methods

The present experiment was carried out during October 2019 in the Laboratory of Department of Floriculture and Landscape Architecture, KNK College of Horticulture, Mandsaur, Rajmata Vijayareje Scindhia Krishi Vishwa Vidyalaya, Gwalior. The experiment was laid out in Completely Randomized Block Design in three replication with fourteen treatment of different chemical preservatives (Sucrose, $AgNO_3$ and Boric Acid). The variety used in the experiment was Top Secret. The flowers of uniform size and colour, free from pests and disease were selected for the experiment. After harvesting at tight bud stage the flowers were placed immediately in clean water. Harvested flowers were kept under shade and transported within 5 hours to the laboratory. Then flowers were brought to the laboratory and washed with deionized water to remove dust from the surface of the flower cutting. The dust-free samples were then randomly divided into fourteen groups with 3 replications, containing one flower cutting in each replication.

Different concentration of Sucrose, $AgNO_3$ and Boric Acid solution were prepared and distilled water used to make the dilutions. The same distilled water used as control (T_1). Sucrose, $AgNO_3$ and Boric Acid were combined as a new treatments like T_2 (Sucrose 2.0%), T_3 (Silver Nitrate 30 ppm), T_4 (Silver Nitrate 60 ppm), T_5 (Boric Acid 75mg/l of water), T_6 (Boric Acid 100mg/l of water), T_7(Sucrose 2.0% + Silver Nitrate 30 ppm), T_8 (Sucrose 2.0% + Silver Nitrate 60 ppm), T_9 (Sucrose 2.0% + Boric Acid 75mg/l of water), T_{10} (Sucrose 2.0%+ Boric Acid 100mg/l of water), T_{11} (Sucrose 2.0% + Silver Nitrate 30 ppm +Boric Acid 75mg/l of water), T_{12} (Sucrose 2.0% + Silver Nitrate 30 ppm + Boric Acid 100mg/l of water), T_{13} (Sucrose 2.0% + Silver Nitrate 60 ppm + Boric Acid 75mg/l of water), T_{14} (Sucrose 2.0%+ Silver Nitrate 60 ppm + Boric Acid 100mg/l of water) were used for experiment. Data were collected on days taken to first petal spreading, solution uptake change in weight of flower, relative fresh weight of flower, flower freshness score, petal discoloration score, Maximum flower head diameter, change in chlorophyll content, vase life. Relative fresh weight was calculated through below formula

Relative Fresh weight at 3rd day = Final Weight of flower / Initial weight x 100

Freshness of flower was observed on 5th day of vase. Freshness of flower was scored on 1-5 scale (1 = fresh flower, 2 = very slight petal enrolling, 3 = noticeable in-rolling, 4 = petal shriveling and 5 = maximum petal shriveling), (Macnish *et al.,* 1999) [15]. The MFHD of five cut flowers in each replication were recorded using the procedure of Van Doorn *et al.,* (1991) [26]. Flower petal color change or discoloration (fading) was assessed according to the procedures described by Macnish *et al.,* (1999) [15] with rating scale of 1 = none/slight fading, 2 = moderate fading and 3 = advanced fading.

Tissue sap was extracted from ten petals and TSS was determined using digital Refractrometer (model: RFM 840, Japan) by placing two drops of clear juice on the prism surface and reading was taken as described by Lacey *et al* (2001) [14]. Data were taken at first day of vase and 3rd day of vase and difference between these two reading is known as change in TSS and expressed in ^oBrix. Chlorophyll content was estimated in leaf from the top (fully expended leaf) with the help of chlorophyll meter (SPAD-502 plus) in flower stem. Chlorophyll content is expressed in terms of SPAD units. Data were taken at first day of vase and 5th day of vase. The difference between the initial value (on 1st day) and final value (on 5th day of vase) was expressed as the change in chlorophyll content.

Result and Discussion

Days taken for 1st petal spreading

The day's taken to 1st petal spreading was varied from 1.60 to 2.93 days. The maximum days taken to 1st petal spreading (2.93days) was recorded with T_1(Control). While the minimum days taken to 1st petal spreading (1.60 days) was recorded with T_{11}(Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water).

Solution uptake (ml) of flowers

The effect of preservatives on solution uptake (ml) by the cut rose cv. Top Secret on 3rd day, 5th day and at senescence (total solution uptake) was statistically significant.

The maximum solution uptake at 3rd day (49.73 ml) was recorded with T_4 ($AgNo_3$ 60 ppm) followed by 48.93 ml with T_6 (Boric Acid 100 mg/l of water), 38.27 ml with T_3 ($AgNo_3$ 30 ppm).T_4 shows statistically better than other treatments. The minimum solution uptake on 3rd day was (16.50 ml) with T_2 (Sucrose 2.0%) followed by 19.27 ml recorded with T_1

(control). The maximum solution uptake at 5th day (75.87 ml) was recorded with treatment T_4 ($AgNo_3$ 60 ppm) followed by 58.67 ml with T_3 ($AgNo_3$ 30 ppm), 57.67 ml with T_6 (Boric Acid 100 mg/ l of water). The minimum solution uptake at 5th day (27.13 ml) was recorded with T_2 (Sucrose 2%) followed by 33.93 ml with T_1 (Control). The maximum solution uptake at senescence (80.67 ml) was recorded with T_4 ($AgNo_3$ 60 ppm) followed by was 62.80 ml with T_3 ($AgNo_3$ 30 ppm), 60.20 ml with T_6 (Boric Acid 100 mg/ l of water) and minimum solution uptake at senescence (40.40 ml) recorded with T_2(Sucrose 2.0%) followed by 42.8 ml with T_1 (Control).Solution uptake of cut flowers were depends on the type of preservative solutions. This solution uptake by flower might be due to the fact that the $AgNO_3$ present in the holding solution acted as a biocide inhibiting microbial population that might have resulted in blockage of the vascular tissues. The results are in close conformity with the findings observed by Kesta *et al*., (1995) [13].

Change in weight of flower (g)

The effect of post-harvest preservatives on change in fresh weight of flower on 3rd day and at senescence was statistically significant. The maximum increase in fresh weight of flower (3.41 g) on 3rd day was observed in T_4 ($AgNo_3$ 60 ppm) followed by 2.57 g recorded with T_7 (Sucrose 2%+ $AgNo_3$ 30 ppm) both of these are statistically at par to each other. The minimum increase in fresh weight of flower at 3rd day of vase life (0.82 g) was recorded with T_2 (Sucrose 2%) followed by 0.93 g with T_1 (Control) and both of these are statistically smilar to each other. The maximum change in fresh weight on 5th day of vase (4.22 g) was observed with T_4($AgNo_3$ 60 ppm) followed by T_7 (Sucrose 2.0% + $AgNo_3$ 30 ppm) and T_3 ($AgNo_3$ 30 ppm) which recorded the value 4.19 and 3.63 g respectively. The minimum change in fresh weight (2.71 g) was recorded with T_1 (Control). The perusal of data revealed that minimum change in fresh weight at senescence (-1.25 g) was recorded withT_{11} (Sucrose 2.0% + AgNo3 30 ppm+ Boric Acid 75 mg/l of water) followed by -1.35 g with T_{12} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 100 mg/l of water), -1.69 g with T_7, -1.67 g with T_8 and all of these treatments are statistically at par to each other. The maximum change in weight at senescence (-4.39 g) was recorded with T_4 ($AgNo_3$ 60 ppm) followed by T_3, T_1, T_2, and T_5 which recorded the value of 4.28, 4.14, 3.12 and 3.12 respectively. All of these treatments are at par to each other. The similar results were also reported by Amariutei *et al.*, (1986) [1] in gerbera who revealed that the dry weight of flowers was greater in pulsed inflorescences than those in water only Similar results were observed by Das *et al.* (2008) [4], they reported that the flower preservatives maintain higher fresh weight due to reduction in respiration and transpiration rate and check deterioration of cell ultra structure.

Relative fresh weight of flowers (%)

The effects of preservatives on relative fresh weight of flowers are statistically significant. The maximum relative fresh weight at 3rd day (128.44%.) was recorded with T_4 ($AgNo_3$60 ppm) and followed by T_7(Sucrose 2% + $AgNo_3$ 30 ppm) which recorded 123.22% and both are statistically similar to each other. The minimum relative fresh weight at 3rdday (106.04%) was recorded with T_2 (Sucrose 2.0%). Relative fresh weight at 5th day of vase was varied from 120.65 to 137.83%.The maximum relative fresh weight at 5thday (137.83%) was recorded with T_7(Sucrose 2% + $AgNo_3$ 30 ppm) followed by T_4($AgNo_3$ 60 ppm) which recorded 135.17% and all of these treatments are statistically at par to each other. The minimum relative fresh weight at 5thday (120.65%) was recorded with T_8 (Sucrose 2.0% +Boric Acid 75 mg/l). Relative fresh weight at senescence is varied from 63.42% to 87.87%. The maximum relative fresh weight at senescence (87.87%) was recorded by T_{12} (Sucrose 2% +$AgNo_3$ 30 ppm + Boric Acid 100mg/l of water) followed by 87.69% with T_{11} (Sucrose 2% +$AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water, 84.73% with T_7, 83.88% with T_9 and all of these treatments are statistically at par to each other. The minimum relative fresh weight at senescence (63.42%) was recorded with T_4($AgNo_3$ 60 ppm). Similar results were observed by Das *et al*, (2008) [4], they reported that the flower preservatives maintain higher fresh weight due to reduction in respiration and transpiration rate and check deterioration of cell ultra structure.

Flower freshness score

The effects of post-harvest preservatives on flower freshness score are statistically significant. The best result with respect of flower freshness score (1.67) was recorded with T_{11} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75mg/l of water) followed by 2.00 with T_{12} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 100mg/l of water) and both of these are statistically at par to each other. The maximum flower freshness score (3.00) was observed with T_1(Control) followed by 2.87 with T_9(Sucrose 2.% +Boric Acid 75mg/l of water). 2.80, 2.73, recorded with T_{10} (Sucrose 2.0% + Boric Acid 100mg/l of water) and T_2 (Sucrose 2%) respectively and all of these treatments are at par to each other. Post-harvest preservatives contain anti ethylene compounds, which is beneficial for maintenance of flowers as fresh as possible for a longer period. These results are in close conformity with the findings observed by Mehraj *et al.* (2013) [16].

Maximum flower head diameter (MFHD)

The effects of post harvest preservatives are statistically significant. The maximum flower head diameter (7.67cm) was recorded with T_{11} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water) followed by 7.34 cm and 7.24 cm recorded with T_{12} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 100 mg/l of water) and T_{10} (Sucrose 2.0% + Boric Acid 100mg/l of water) respectively, all of these treatments are statistically at par to each other. The minimum Flower head diameter (5.24 cm) was observed in T_1 (Control). These results are confirmed by Ichimura *et al*. (2005, 2006) [10, 11].

Petal Discoloration score

The effects of post harvest preservatives on petal discoloration score are statistically significant. The best result with respect of petal discolouration score (3.07) was recorded with T_{11} (Sucrose 2.0%+$AgNo_3$ 30 ppm + Boric Acid 75mg/l of water) and T_{12}(Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 100mg/l of water).The maximum petal discoloration score (5.00) was recorded with T_1(Control) followed by 4.87 with T_9 (Sucrose 2%+Boric Acid 75mg/l of water),T_{10}(Sucrose 2%+Boric Acid 100mg/l of water) and T_2,(Sucrose 2%) all of these treatments are statistically at par to each other. In this case sucrose may act as the CHO supplier and $AgNo_3$ and Boric acid acted as the germicides. Addition of sugar to the vase solution counteracted the adverse effects of defoliation on petal color and overcome the increased bud blasting (Susan, 2003) [24]. These results are advocated by Mehraj *et al.* (2013) [16].

Change in total soluble solid TSS (^{0}B)

The effect of post harvest preservatives on change in total soluble solid are statistically non significant. The maximum change in total soluble solid TSS (1.51^{0}B) was recorded with

T_{14} (Sucrose 2.0% + $AgNo_3$ 60 ppm + Boric Acid 100 mg/l of water) followed by 1.41^0B with T_{12}(Sucrose 2.0% + $AgNo_3$30 ppm + Boric Acid 100 mg/l of water), 1.39^0B with T_{11}(Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water).The minimum change in total soluble solid (1.02^0B) was recorded with T_2 (Sucrose 2.0%).

Change in chlorophyll content

The effect of post harvest preservatives are statistically significant. The maximum change in chlorophyll content (1.60) was recorded with T_1 (control) followed by1.34 with T_8(Sucrose 2.0% + $AgNo_3$ 60 ppm) and 1.39 with T_4($AgNo_3$ 60 ppm). The minimum chlorophyll content (0.72) was recorded with T_{11}(Sucrose 2.0% + $AgNo_3$30 ppm +Boric Acid 75mg/l of water)and T_{12}.(Sucrose 2.0% + $AgNo_3$30 ppm +Boric Acid 100 mg/l of water). All of the preservatives used in this experiment such as $AgNO_3$, boric acid with or without sucrose and sucrose individually show the positive effect on preserving the leaves in good condition by let down the%of wilting and inhibiting the chlorophyll and carbohydrate degradation. Similar results were obtained by Serek *et al.* (1996) [23], Singh and Tiwari (2002) [25]; Harode *et al.* (1993) [9] and Reddy *et al.* (1988).

Change in Anthocyanin content

The effect of post harvest preservatives are statistically non-significant. The maximum change in anthocyanin content recorded with (210.15mg/100 g) with T_1 (Control)followed by 190.13 with T_2(Sucrose 2%) and both are at par to each other. The minimum change in anthocyanin content (170.21mg) recorded with T_3($AgNo_3$ 30 ppm).

Vase life (days)

The effect of post harvest preservatives on vase life was statistically significant. The maximum vase life (9.0 days) was recorded with T_{11} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75mg/l of water) followed by 8.95 days with T_{12} (Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 100 mg/l of water), 8.40 days with T_{13}(Sucrose 2.0% + $AgNo_3$ 60 ppm + Boric Acid 75 mg/l of water), 8.23 days with T_{14} (Sucrose 2.0% + $AgNo_3$ 60 ppm + Boric Acid 100 mg/l of water).The minimum vase life (5.40 days) was observed in T_1(Control) followed by 5.47 day with T_2 (Sucrose), 6.53 days with T_5(Boric Acid 75 mg/l), 6.67 days with T_6 (Boric Acid 100 mg/l of water). The vase life of cut rose flowers is primarily influenced by water balance, which is determined by water loss and water uptake (Fanourakis *et al.*, 2013) [7]. Silver nitrate ($AgNO_3$) and Boric Acid are very potent inhibitors of ethylene action in plant tissues. The treatment of Sucrose + $AgNo_3$ + Boric Acid may be decreased the ethylene production and helpful to increase the vase life of rose as comparison to control. It is also provides some antimicrobial activity inside the plant tissues, thus its beneficial for rose flowers. These results are confirmed by Bartoli *et al.* (1997) [2] and WeiMing *et al.* (1997) [27].

Table 1: Effect of post harvest preservatives on vase life of cut roses

Treatments	Days taken for 1st petal spreading	Solution uptake at 3rd day (ml)	Solution uptake at 5th day (ml)	Solution uptake at senescence day (ml)	Change in weight of flower 3rd day of vase	Change in weight of flower 5th day of vase	Change in weight of flower senescence day of vase	Relative fresh weight at 3rd day	Relative fresh weight at 5th day	Relative fresh weight at senescence
Control	2.93	19.27	33.93	42.80	0.93	2.71	-4.14	107.53	121.87	66.59
Sucrose (2.0%)	2.33	16.50	27.13	40.40	0.82	3.61	-3.12	106.04	126.55	77.03
$AgNo_3$ (30 ppm)	2.00	38.27	58.67	62.80	1.05	3.63	-4.28	107.31	125.18	70.31
$AgNo_3$ (60 ppm)	2.00	49.73	75.87	80.67	3.41	4.22	-4.39	128.35	135.17	63.42
Boric Acid (75 mg/l of water)	2.13	31.00	47.87	53.87	1.01	3.39	-3.12	109.55	132.15	70.41
Boric Acid (100 mg/l of water)	2.27	43.93	57.67	60.20	1.63	2.95	-2.97	117.08	130.94	68.81
Sucrose (2.0%) + $AgNo_3$ (30 ppm)	2.07	29.20	52.80	54.60	2.57	4.19	-1.69	123.22	137.83	84.73
Sucrose (2.0%) + $AgNo_3$ (60 ppm)	2.13	27.67	46.73	50.97	2.07	2.80	-1.67	120.80	128.19	83.16
Sucrose 2.0%) + Boric Acid (75 mg/l of water)	1.80	26.20	35.00	48.73	0.96	2.37	-1.85	108.34	120.65	83.88
Sucrose (2.0%) + Boric Acid (100 mg/l of water)	1.87	27.00	46.53	51.40	1.34	3.07	-1.94	113.97	131.46	80.12
Sucrose (2.0%) + $AgNo_3$ (30 ppm) + Boric Acid (75mg/l of water)	1.60	24.53	46.13	52.20	2.10	3.17	-1.25	120.51	130.99	87.69
Sucrose (2.0%) + $AgNo_3$ (30 ppm) + Boric Acid (100 mg/l of water)	1.73	23.87	46.07	56.07	1.94	3.16	-1.35	110.74	128.40	87.87
Sucrose (2.0%) + $AgNo_3$ (60 ppm) + Boric Acid (75 mg/l of water)	1.93	23.47	36.93	46.93	1.75	2.74	-1.80	124.57	130.50	79.96
Sucrose (2.0%) + $AgNo_3$ (60 ppm) + Boric Acid (100 mg/l of water)	1.93	22.07	48.93	51.07	1.91	2.76	-1.76	119.09	127.58	82.41
S.E.m±	0.16	2.50	3.60	2.69	0.41	0.43	0.37	2.15	7.00	3.24
CD at 5%	0.46	7.25	10.43	7.80	1.18	1.23	1.90	6.22	20.28	9.39

Table 2: Effect of post harvest preservatives on vase life of cut roses

Treatments	Flower freshness score	Maximum flower head diameter	Petal discoloration score	Change in Total Soluble Solid	Change in Chlorophyll content	Change in Anthocyanin content	Vase life (days)
Control	3.00	5.24	5.00	1.02	1.60	210.15	5.40
Sucrose (2.0%)	2.73	6.74	4.87	1.15	1.30	190.13	5.47
$AgNo_3$ (30 ppm)	2.47	6.78	4.67	1.09	1.51	170.21	7.33
$AgNo_3$ (60 ppm)	2.40	6.55	4.07	1.10	1.39	180.28	7.53
Boric Acid (75 mg/l of water)	2.60	6.67	4.73	1.23	0.90	200.15	6.53
Boric Acid (100 mg/l of water)	2.47	6.74	4.67	1.21	0.95	200.18	6.67
Sucrose (2.0%) + $AgNo_3$ (30 ppm)	2.40	6.18	3.73	1.08	1.01	200.07	6.93
Sucrose (2.0%) + $AgNo_3$ (60 ppm)	2.60	6.93	4.53	1.24	1.34	190.21	7.33
Sucrose 2.0%) + Boric Acid (75 mg/l of water)	2.87	6.90	4.87	1.27	0.89	190.19	7.00
Sucrose (2.0%) + Boric Acid (100 mg/l of water)	2.80	7.24	4.87	1.29	0.77	185.33	6.67
Sucrose (2.0%) + $AgNo_3$ (30 ppm) + Boric Acid (75mg/l of water)	1.67	7.67	3.07	1.39	0.72	170.40	9.00
Sucrose (2.0%) + $AgNo_3$ (30 ppm) + Boric Acid (100 mg/l of water)	2.00	7.34	3.07	1.41	0.72	175.22	8.95
Sucrose (2.0%) + $AgNo_3$ (60 ppm) + Boric Acid (75 mg/l of water)	2.20	7.33	4.87	1.36	0.97	180.21	8.40
Sucrose (2.0%) + $AgNo_3$ (60 ppm) + Boric Acid (100 mg/l of water)	2.40	7.30	4.40	1.51	0.99	180.18	8.23
S.E.m±	0.10	0.18	0.21	0.10	0.07	4.71	0.27
CD at 5%	0.30	0.51	0.60	0.29	0.19	13.71	0.78

Conclusion

Among the preservatives evaluated in this experiment, different preservatives show the best result with respect of different parameters. T_{11} Sucrose 2.0% + $AgNo_3$ 30 ppm + Boric Acid 75 mg/l of water) recorded the best performance with respect of days taken to 1st petal spreading, change in weight of flowers at senescence, flower freshness score, maximum flower head diameter, petal discoloration score, change in TSS, change in chlorophyll content, change in anthocyanin content and vase life. While T_4($AgNo_3$ 60 ppm) showed the best result with respect of solution uptake at 3rd day, 5th day and at senescence, change in weight of flowers at 3rd day of vase, at 5th day of vase and relative fresh weight at 3rd day of vase.

T_{12} (Sucrose 2% + $AgNo_3$ 30 ppm + Boric Acid 100mg/l of water) shows excellent result with respect to relative fresh weight at senescence and petal discolouration score while T_7(Sucrose 2% + $AgNo_3$ 30 ppm) shows the best performance in respect of relative fresh weight at 5th day of vase.

Reference

1. Amariutei A, Burzo I, Alexe C. Researchers concerning some metabolism aspects of cut gerbera flowers. Acta Hort. 1986;1:331-337.
2. Bartoli CG, Juan G, Edgrdo M. Ethylene production and responses to exogenous ethylene in senescing petals of Chrysanthemum morifolium RAM cv. Unsei. Plant Sci. 1997;124(97):15-21.
3. Cho HK, Lee JM. Studies on extending the vase life of cut flowers of rose and carnation with various chemical preservatives. J KSHS 1980;20:106-110.
4. Das, Chakraborty S, Munsi PS, Tarafder J, Roychowdhury N. Effect of sucrose and trehalose on vase life and flower quality of gerbera. J. ornamental Hort 2008;11(3):188-195.
5. Elgimabi MENE. Vase life extension of rose cut flowers (*Rosa hybrida*) as influenced by silver nitrate and sucrose pulsing. Amer. J. Agric. Biol. Sci 2011;6(1):128-133.
6. Farahat MM, Abd-El-Aziz NGA, Hashish Kh I, Gaber A. Postharvest physiology and vase life of rose (*Rosa hybrid* l. cv. grand prix) cut flowers as influenced by using sucrose and some chemical treatments. Middle East J. Agric. Res. 2014;3(4):815-819.
7. Fanourakisa D, Pieruschkaa R, Savvidesb AC, Macnishd AJ, Sarlikioti VE, Ernst J *et al*. Sources of vase life variation in cut roses Postharvest. Bio. & Tech. 2013;78:1-15.
8. Figueroa B, Colinas MT, Mejía J, Ramírez F. Postharvest physiological changes in roses of different vase life. Ciencia E Invest. Agric 2005;32:1-10.
9. Harode SM, Kotake VG, Zend JP. Effects of selected treatments on longevity and freshness of selected flowers in home decoration. J. Maharshtra Agricul. Univ. 1993;18:448-450.
10. Ichimura K, Kishimoto M, Ryo N, Yoshihiko K. Soluble carbohydrates and variation in vase-life of cut rose cultivars 'Delilah' and 'Sonia'. J. Hort. Sci. Biotechnol 2005;80:280-286.
11. Ichimura K, Taguch M, Norikoshi R. Extension of the vase life in cut roses by treatment with glucose, isothiazolinonic germicide, citric acid and aluminum sulphate solution. J. Agri. Resear 2006;40:263-269.
12. Kaltaler REL, Steponkus PL. Factors affecting respiration in cut roses. J AMER. Soc. Hort. Sci 1976;101:352-354.
13. Ketsa S, Piyasaengthong Y, Prathuangwong S. Mode of Action of Silver nitrate in Maximizing Vase Life of Dendrobium Pompadour Flowers. *Postharvest Bio. Tech.* 1995;5:109-117.
14. Lacey L, McCarthy A, Foord G. Maturity testing of citrus. Farmnote, Dep. Agri. West. Australia 2001;3:1-5.
15. Macnish AJ, Simons DH, Joyee DC, Faragher JD, Hofman PJ. Response of native Australian cut flower to treatment with 1-methylcyclopropene and ethylene. Hort. Sci 1999;35:254-255.
16. Mehraj H, Ona AF, Taufique T, Mutahera S, jamal Uddin AfM. Vase life quality improvement ofSnoball using vase life extending solution. Bangladesh Research Publications Journal 2013;8:191-194.
17. Mehraj H, Taufiqueb T, Shamsuzzohab MI, Shiamb H, Jamal-Uddin AFM. Effects of floral preservative solutions for vase life evaluation of Gerbera. J. Biosci. Agric. Res. 2016;09(02):804-811.

18. Muhammad SM, Hiroyasu S, Shahzad N. Diversity in roses. Nat. Agric. Res. Center, Islamabad, 1996, 1-2.
19. Reddy BS, Singh K, Singh A. Effect of Sucrose, Citric Acid and 8-Hydroxyquinoline Sulphate on the Postharvest Physiology of Tuberose Cv. Single. Advances in Agricultural-Research-in-India 1995;3(10):161-167.
20. Roodbaraky F, Hashemabad D, Vand SH. Effect of salicylic acid on vase life of cut carnation (*Dianthus caryophyllus* L. cv. 'Liberty Abgr'). Ann. Biol. Res 2012;3(11):5127-5129.
21. Sarkka L. Yield quality and vase life of cut roses in year round greenhouse production. Academic Dissertation, University of Helsinki, Finland 2005, 64.
22. Serrano MA, Amoros MT, Pretel MC, Merinez-Madrid, Romojaro F. Preservative solution nano-silver containing boric acid delay senescence of carnation flowers. Postharvest Biol. Technol 2001;23:133-142.
23. Serek M, Sisler E, Reid M. Ethylene and the postharvest performance of miniature roses. Acta Hort. 1996;424:145-150.
24. Susan SH. Role of sugar in the vase solution on post-harvest flower and leaf quality of oriental lily 'Stargazer'. Hort. Sci 2003;38(3):412-416.
25. Tiwari AK, Singh R. Effect of antimicrobial compounds on the postharvest life of rose. Appl. Hort. 2002;4:52-53.
26. Van Droonn WG, Zagary D, de Witte Y, Harkema H. Effect of vase-water bacteria on the senescence of cut carnation flowers. Postharvest Biol Technol 1991;1:161-168.
27. Wei Ming G, Zeng W, Chen F. Regulationof ethylene on senescence of cut chrysanthemumflower. J. Nanjing Agric. Univ 1997;20:24-29.
28. Zlesak DC. Rose. In: N. Anderson (ed) Flower breeding and genetics. Issues Challenges and Opportunities, Springer Netherland 2006, 695-738.