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Short Communication

Effect of Pulsing Solution and Floral Preservatives on Vase Life of Gerbera (*Gerbera jamesonii*) Var. Red Torrossa

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Gerbera (*Gerbera jamesonii*) also known as Transvaal daisy, Barbeton daisy or African daisy belonging to family Asteraceae occupies 5th place as cut flower in international flower trade. It is popular because of its attractive colour, long vase life and suitability for long distant transport. Many preservative solutions were introduced to increase the quality and vase life of cut flowers. One of the methods includes submerging the flower heads for a few minutes in 0.1 mM benzyl adenine (BA) to maintain flower weight and senescence. The quality loss of cut flowers may depend on various factors [1]. To be specific, for gerbera flowers, factors such as genetic, postharvest storage temperature, phytohormones [2] and water balance [3] are the main causes of postharvest petal wilting and stem bent neck and/or stem break. It is well documented that one of the main causes for the inferior quality of cut flowers is the blockage of xylem vessels by microorganisms that accumulate in the vase solution or in the vascular vessels of the plant. When the vessels of stems become blocked, water uptake and transpiration by leaves cause a net loss of water from the cut flower [4]. Many substances have been used in cut flower vase solutions to extend the postharvest life of plants by reducing microbial contamination. Bactericides are the most important components in preservative solutions used to control bacteria and to prevent bacterial embolism [5]. Other materials that have been successfully tested in preservatives include 6% sucrose [6]. Sucrose has been used as a substrate for respiration [7], which helps to maintain the osmotic potential of the petal cells [8]. Pre-treatment of cut roses with thymol (100 mg L-1) have been found effective against some bacteria [9]. Solgi *et al*. [10] reported that pre-treatment of *Gerbera jamesonii* 'Dune' with nano-silver particles (SNPs) was effective as an antibacterial agent [11]. Nano-silver (NS) particles more strongly inhibit bacteria and other microorganisms than normal silver element in various oxidation states, i.e., Ag0, Ag^+, $Ag2^+$ and $Ag3^+$ [12]. Benzyl adenine is a common growth hormone used for extending the shelf life of many horticultural crops. BA at different concentrations improved membrane stability index that led to better flower vase life. Treatment with 10 ppm BAP could be a useful method to extend shelf life of fresh-cut broccoli florets during storage at 6±1 °C at commercial level [13]. 8 HQC is an another ethylrnr inhibitor known to use to extend vase life of flower crops. With this background, an experiment was laid out to find the influence of various ethylene inhibitors to extend the vase life of gerbera.

An investigation was undertaken to study the influence of pulsing and preservative solution on vase life of cut gerbera (*Gerbera jamesonii*) var. Red Torrossa" was under taken during 2020-2021 to improve the post-harvest vase life of cut gerbera. The experiment was conducted with pulsing and holding solution at various concentrations viz., P_0- No pulsing, P_1- Sucrose @ 10% and P_2- Sucrose @ 20%. Vase solutions comprise of 10 treatments with 3 concentrations viz., Nano silver (4, 8 and 12 ppm), Benzyl adenine (10, 20 and 30 ppm) and 8-HQC (4, 8 and 12 ppm). Flowers of var. Red Torrossa were assessed by holding them in test tubes kept under ambient mean temperature of 32.4 degree Celsius with relative humidity 73 percent and with 40W cool white fluorescent tubes, on a 12 hours photoperiod. Assessment of pulsing and vase solution was done based on water uptake water (g/flower), water balance water (g/flower), cumulative physiological loss in weight water (%), and vase life (days) were done on 5th day of observations. Fresh flowers were made with a bottom cut and placed in test tubes containing solutions as per the treatment schedule. Three test tubes were maintained for each treatment and replication and studied under factorial completely randomized design.

The results depicted in the (Table 1) shows significant difference among the pulsing as well as holding solution in cut gerbera. Among the pulsing solution, maximum transpiration loss of water (4.20 g/flower) was recorded under the treatment P_2-Sucrose @ 20%. The minimum transpiration loss of water was recorded under the pulsing treatment P_0 – No pulsing with 4.99 g per flower. Among the vase solution, maximum water loss (7.93 g/flower) was recorded under the treatment V_2 (Nano silver @ 8 ppm). This is followed by the treatment V_3 (Nano silver @ 12 ppm) which recorded a water loss of 7.14 g per flower. However, the lowest water loss was recorded under V_{10} (Control) with 3.13 g per flower. Among the interaction of

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pulsing and vase solution treatments, maximum water loss (8.46 g per flower) was recorded under the treatment P_2V_2 (Sucrose @ 20% + Nanosilver @ 8 ppm). The lowest water loss was recorded under the treatment P_0V_{10} (No pulsing + Control) with 2.38 g per flower. The increased transpiration loss in the sucrose treated treatment might be due to higher water uptake to avoid temporary water stress that led to the increase in membrane viscosity and antimicrobial property. It is important to note that the imbalance between water uptake and water loss from cut gerbera stems increases petal wilting and stem breakage. Increased water uptake maintains turgidity, freshness of flowers and thus enhances vase life owing to improved water balance and post-harvest physiology. It is well known that sucrose supply increases the longevity of many cut flowers, since sucrose can act as a source of nutrition for tissues approaching carbohydrate starvation, flower opening and subsequent water relations [14].

Among the pulsing solution, maximum water balance (0.80 g/flower), was recorded under the treatment P_2-Sucrose @ 20% which is followed by P_1-Sucrose @ 20% with 0.78 g per flower on 5th day of observations. The minimum water balance was recorded on P_0 – No pulsing with 0.68 g per flower on 5th day of observation respectively. Among the vase solution, the treatment V_2 (Nano silver @ 8ppm) has maximum water balance on 5th day of observations with 1.16 g per flower. This is followed by the treatment V_3 (Nano silver @ 12 ppm) which recorded a water balance of 1.03 g per flower. However, the lowest water balance was recorded under V_{10} (Control) with 0.48 g per flower at 5th day of observations. Among the interaction of pulsing and vase solution treatments, maximum water balance (1.19 g per flower) was recorded under the treatment P_2V_2 (Sucrose @ 20% + Nano silver @ 8ppm) at 5th day of observation. The lowest water balance was recorded under the treatment P_0V_{10} (No pulsing + Control) with 0.31 g per flower at 5th day of observations. The xylem is mainly responsible for water transport to the flower buds and flowers, so water uptake by cut flowers in a vase can be hindered by the proliferation and growth of microorganisms and the deposition of microbial residue in the lumen of the xylem vessels which can be promoted by accidental mechanical damage during harvest [15].

Nano silver particles have been shown to have stronger bactericidal, fungicidal and viricidal properties than micrometric structures or components of the oxidation states of silver [16] due to their high surface area to volume ratios, small dimensions, quanta and large external area effect. The silver ion that is released by Nano silver particles interacts with cytoplasmic components and nucleic acids to inhibit respiratory chain enzymes and interfere with membrane permeability. This leads to more uptake of water and maintaining water balance in cut stems of gerbera. Zhao *et al*. [17] claimed that nano silver particles not only inhibited bacterial growth in cut *Paeonia lactiflora* flowers but also enhanced antioxidant activity and promoted the expression of the plasma membrane intrinsic protein genes PlPIP1;2 andPlPIP2;1, which helped to maintain the water balance [18-19].

Table 1 Effect of different pulsing solution and floral preservatives on vase life of gerbera cv. Red torrossa

Treatments	Water uptake (g/flower)				Water balance (g/flower)				Cumulative physiological loss in weight (%)				Vase life (days)			
	P_0	P_1	P_2	V Mean	P_0	P_1	P_2	V Mean	P_0	P_1	P_2	V Mean	P_0	P_1	P_2	V Mean
V_1: Nanosilver @ 4ppm	6.45	6.76	7.23	6.81	0.88	0.93	1.00	0.97	35.74	31.79	28.46	32.00	6.74	7.97	8.77	7.83
V_2: Nanosilver @ 8ppm	7.28	8.06	8.46	7.93	1.01	1.13	1.19	1.16	28.71	24.76	21.97	25.15	7.12	8.35	9.23	8.23
V_3: Nanosilver @ 12ppm	6.68	7.27	7.46	7.14	0.92	1.02	1.04	1.03	33.00	29.05	26.71	29.59	6.9	8.13	8.99	8.01
V_4: Benzyl adenine @ 4ppm	6.10	6.21	6.88	6.40	0.84	0.86	0.96	0.91	36.88	32.93	28.67	32.83	6.49	7.72	8.55	7.59
V_5: Benzyl adenine @ 8ppm	5.58	5.93	6.36	5.96	0.77	0.83	0.89	0.86	40.7	36.75	30.09	35.85	6.31	7.54	8.46	7.44
V_6: Benzyl adenine @ 12ppm	5.08	5.38	5.86	5.44	0.70	0.74	0.82	0.78	40.82	36.87	28.84	35.51	6.06	7.29	8.27	7.21
V_7: 8 HQC @ 4ppm	3.02	3.97	3.80	3.60	0.41	0.54	0.52	0.53	46.64	42.69	40.42	43.25	5.08	6.31	7.09	6.16
V_8: 8 HQC @ 8ppm	3.28	4.16	4.06	3.83	0.45	0.57	0.57	0.57	42.74	38.79	37.7	39.74	5.43	6.66	7.27	6.45
V_9: 8 HQC @ 12ppm	4.10	4.64	4.88	4.54	0.56	0.63	0.68	0.65	42.44	38.49	35.42	38.78	5.57	6.80	7.51	6.63
V_{10}: Control	2.38	3.86	3.16	3.13	0.31	0.53	0.43	0.48	56.74	52.79	49.04	52.86	4.95	6.18	6.76	5.96
P Mean	4.99	5.62	5.81		0.68	0.77	0.81		40.44	36.49	32.72		6.06	7.35	8.10	
SED	V	P	V×P		V	P	V×P		V	P	V×P		V	P	V×P	
CD (p=0.05)	0.08	0.03	0.12		0.009	0.003	0.013		0.33	0.13	0.47		0.03	0.02	0.10	
	0.17	0.06	0.24		0.019	0.007	0.027		0.66	0.26	0.94		0.06	0.04	0.21	

Positive influence of nano silver particles along with sucrose on water uptake might be due to antibacterial effect of Ag+ ions that may affect the regulation of water channel activity through inhibition of sulfhydryl-containing proteins and improve solution uptake [20]. Nano silver particles in reducing ethylene production by lowering the transcript level of ethylene biosynthesis genes and in suppressing bacterial growth through their antimicrobial activity, both of which increase the water relations of gerbera noticed in this study [21-23]. It is important to note that the imbalance between water uptake and water loss from cut gerbera stems increases petal wilting and stem breakage. Increased water uptake maintains turgidity, freshness of flowers and thus enhances vase life owing to improved water balance and post-harvest physiology.

The data pertaining to cumulative physiological weight loss showed significant difference among pulsing as well as vase solution treatments. Among the pulsing solution, minimum cumulative physiological weight loss (32.72%) was recorded under the treatment P_2-Sucrose @ 20%. The maximum cumulative physiological weight loss (40.44%) was recorded under treatment P_0 – No pulsing. Among the vase solution, the minimum cumulative physiological weight loss 25.15 % was recorded under the treatment V_2 (Nano silver @ 8 ppm). It is followed by the treatment V_3 (Nano silver @ 12 ppm) which recorded 29.59%. The maximum cumulative physiological weight loss was recorded under V_{10} (Control) 52.86%). Among the interaction of pulsing and vase solution treatments, minimum cumulative physiological weight loss was recorded under P_2V_2 (Sucrose @ 20% + Nano silver @ 8 ppm) of 21.97%. The maximum cumulative physiological weight loss was recorded under the treatment P_0V_{10} (No pulsing+ Control) with 56.74%. The decreased physiological loss in sucrose treated stems may be due to more water uptake and water balance thereby maintaining better tissue water potential.

The quality of flowers is estimated based on longevity, when it is kept indoor for consumer's preference. The postharvest longevity and quality of cut flowers is primarily controlled by the synthesis of ethylene in the petals and the proliferation of microorganisms in the cut stems [24]. The data pertaining to vase life showed significant difference among pulsing as well as vase solution treatments. Among the pulsing solution, maximum vase life (8.10 days) was recorded under the treatment P_2-Sucrose @ 20%. The minimum vase life (6.06 days) was recorded under the treatment P_0 – No pulsing. Among the vase solution, maximum vase life of cut gerbera (8.23 days) was recorded under treatment V_2 (Nano silver @ 8 ppm). It was followed by the treatment V_3 (Nano silver @ 12 ppm) which recorded 8.01 days. The minimum vase life was recorded under V_{10} (Control) 5.96 days respectively. Among the interaction of pulsing and vase solution treatments, maximum vase life was recorded under P_2V_2 (Sucrose @ 20% + Nano silver @ 8 ppm) of 9.23 days. This is followed by 8.91 days in those flowers kept under Sucrose @ 10% + Nano silver @ 12 ppm (P_2V_3). The minimum vase life was recorded under the treatment P_0V_{10} (No Pulsing + Control) with 4.95 days respectively. The superiority of the flowers kept under sucrose solution may be due to increased water uptake maintains turgidity, freshness of flowers and thus enhances vase life owing to improved water balance and post-harvest physiology. The adequate and controlled transpirational loss of water might have contributed to the retardation of senescence process and hence increased the vase life of gerberas [25].

SUMMARY

An investigation was carried out to find the effect of certain preservative and vase solution to extend the post-harvest life of gerbera (*Gerbera jamesonii*) var. Red Torrossa in the Department of Horticulture, Annamalai University during 2020-21. The experiment was conducted with pulsing and holding solution at various concentrations viz., P_0- No pulsing, P_1- Sucrose @ 10% and P_2- Sucrose @ 20%. Vase solutions comprise of 9 treatments with 3 concentrations viz., Nano silver (4, 8 and 12 ppm) and Benzyl adenine (10, 20 and 30 ppm) and 8 –HQC (4, 8 and 12 ppm). Assessment of pulsing and vase solution was done based on water uptake water (g/flower), water balance water (g/flower), cumulative physiological loss in weight water (%), and vase life (days). From the experiment it evident that maximum transpiration loss of water, fresh weight change, stem strength and vase life recorded maximum values under the treatment P_1V_2 (Pusling @ 20% and Nano Silver @ 8 ppm). From the experiment it is concluded that the gerbera var. Red Torrossa performed better in pulsing P_2-sucrose 20% and holding solution V_2- Nano silver @ 8 ppm.

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