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Effect of Floral preservatives in improving the vase life of Gypsophila (*Gypsophila. Paniculata*) cv. crystal white

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Abstract
An experiment was conducted to study the effect of different concentrations of floral preservatives on vase life of gypsophila flowers at Floricultura, l Research Station, SKLTSHU, Rajendranagar, Hyderabad during 2019 - 2020 and 2020 - 2021. The results of the experiment revealed that, among the different floral preservatives studied, the treatment cobalt chloride at 100 ppm was very effective in increasing the vase life of gypsophila flowers (13.33 days). It has led to increased water uptake (15.23 g/f), transpirational loss of water (16.72g/f), maximum fresh weight change (106.92%), water balance (4.840 g/f), minimum physiological loss in weight (4.71%), minimum optical density (1.735) and low microbial count (6.040 x 10^{-5} cfu/ml.) and control (distilled water) recorded minimum vase life (5.10 days), water uptake (7.44 g/f), transpirational loss of water (10.39 g/f) fresh weight change (85.15%), water balance (2.640 g/f) maximum physiological loss in weight (8.78%), maximum optical density value (1.858) and high microbial count (7.580x 10^{-}5 cfu/ml).

Keywords: Floral preservatives (Aluminium sulphate 100,200 and 300 ppm, Cobalt chloride 100,200 and 300 ppm, Sodium benzoate 100,200 and 300 ppm.) Water uptake, Transpirational loss of water, water balance, fresh weight change, Physiological loss in weight, optical density, microbial count, vase life and gypsophila flowers cv. crystal white

Introduction
Gypsophila **(***Gypsophila paniculata* L.) belongs to caryophyllaceae family which is commonly called as Baby's - breath' and is native to Central and Eastern Europe. The genus name is derived from the greek word 'Gypsos' (Gypsum) and 'philos' (loving) refers to the growth of the plant on gypsum rich substrates. Many species are found on calcium rich soils, including gypsum, which is depicted in the name of the genus " gypsophila " (Walker, 1994) [17]. It is an hardy perennial plant with deep tap root system. Flowers are produced usually in profusely branched panicles. The light airy mosses of small white to pink flowers of gypsophila makes good contrast to large flowers in bouquets as flower filler which had importance as cut flower in floristry. It is one among the top ten international cut flowers. Extract from the roots of Gypsophila have been used as a gold polish and fabric softener and also been used to prepare foods such as herbal cheese and ice cream (Korkmaz and Ozcelik, 2011) [10]. Crude extracts from Gypsophila species are cytotoxic to tumour inducing macrophage cell lines and may be useful in fighting cancer (Gevrenova *et al.,* 2014) [5].

Materials and Methods
The experiment was carried out at Floricultural Research Station, Rajendranagar, Hyderabad, during the years 2019 and 2020 with different concentrations of floral preservatives viz., Aluminium sulphate 100,200 and 300 ppm, Cobalt chloride 100,200 and 300 ppm, Sodium benzoate 100,200 and 300 ppm.) for enhancing the vase life of gypsophila flowers. Uniform spikes of 60 cm length with more than 75% open florets were harvested and used in this study. The harvested spikes were placed in 500 ml glass bottles with 200 ml of floral preservative solutions at varying concentrations of 100,200 and 300 ppm and distilled water (control) to carry out the vase life studies. Data related to water uptake (g/f), transpirational loss of water (g/f), water balance (g/f), fresh weight change (%) Physiological loss in weight, microbial count and vase life (days) was recorded and statistically analysed using OPSTAT software and the difference of means was compared at five per cent level of significance.

Results and discussion

Water uptake (g/f)

The water uptake of gypsophila flowers differed significantly with different treatments of floral preservatives. Significantly highest mean of water uptake was recorded in the treatment (T_4) Cobalt chloride 100ppm on 2nd day (16.67 g/f), 4th day (15.73 g/f), 6th day (15.17 g/f), 8th day (13.33 g/f) and over all mean value (15.23 g/f) which is on par with (T_5) Cobalt chloride 200ppm on 2nd day (15.98g/f), 4th day (15.02 g/f), 6th day (14.65 g/f), 8th day (13.02 g/f) and over all mean value (14.67). However, the treatment, (T_{10}) control (distilled water) recorded significantly lowest values on 2nd day (8.50 g/f), 4th day (8.33 g/f), 6th day (6.50 g/f), 8th day (6.42 g/f) and over all mean value (7.44 g/f). The remaining treatments recorded intermediate results and were on par with each other and there was gradual decrease of water uptake from 2nd day to 14th day of vase life study of gypsophila cut flowers.

Cobalt chloride 100 ppm was the best floral preservative as it recorded highest water uptake by inhibition of vascular blockage in the stems and maintained high water flow rate through stems. Similar results were also reported by Elham *et al*., (2014) [4] in cut roses and also the antimicrobial property of Cobalt chloride and aluminum sulphate which curtailed the growth of microbes in vase solution and prevented the blockage of conducting tissues by reducing the formation of air cavities. Similar results were also reported by Bhanumurthy (2013) [2] in cut gerbera cv. Savannah.

Transpirational loss of Water (g/f)

The gypsophila flowers held under different floral preservatives differed significantly in TLW. Significantly highest mean of TLW was recorded in the treatment (T_4) Cobalt chloride 100 ppm on 2nd day (17.96 g/f), 4th day (17.33 g/f), 6th day (16.39 g/f), 8th day (15.20 g/f) and over all mean value(16.72 g/f) which is on par with (T_5) Cobalt chloride 200 ppm on 2nd day (17.23 g/f), 4th day (16.95g/f), 6th day (15.83 g/f), 8th day (14.72 g/f) and over all mean value(16.18 g/f) and (T_6) Cobalt chloride 300 ppm on 2nd day (16.89 g/f), 4th day (16.25g/f), 6th day (15.80 g/f), 8th day (14.27 g/f) and over all mean value (15.80 g/f) However, the treatment, (T_{10}) control (distilled water) recorded significantly lowest values on 2nd day (12.15 g/f), 4th day (11.12 g/f), 6th day (10.17 g/f), 8th day (8.15 g/f) and over all mean value (10.39 g/f). The remaining treatments recorded intermediate results and were on par with each other and there was gradual decrease of transpirational loss of water from 2nd day to 14th day of vase life study of gypsophila cut flowers.

This might be due to higher WU to avoid temporary water stress that led to increase in membrane viscosity. These results are in conformity with Halevy *et al.*, (1978) [7] and Faragher *et al.* (1984) [5] in rose flowers.

Water Balance (g/f)

The flowers held at different floral preservatives differed significantly on water balance with highest mean of WB recorded in the treatment (T_4) Cobalt chloride 100ppm on 2nd day (5.521 g/f), 4th day (4.740 g/f), 6th day (4.660 g/f), 8th day (4.440 g/f) and over all mean value (4.840 g/f) which is on par with (T_5) Cobalt chloride 200ppm on 2nd day (5.489 g/f), 4th day (4.718g/f), 6th day (4.662 g/f), 8th day (4.430 g/f) and over all mean value (4.815 g/f) and (T_6) Cobalt chloride 300ppm on 2nd day (5.473 g/f), 4th day (4.723 g/f), 6th day (4.593 g/f), 8th day (4.398 g/f) and over all mean value (4.796 g/f). However, the treatment, (T_{10}) control (distilled water) recorded significantly lowest values on 2nd day (2.870 g/f), 4th day (2.670 g/f), 6th day (2.560 g/f), 8th day (2.460 g/f) and over all mean (2.640 g/f). The remaining treatments recorded intermediate results and were on par with each other and there was gradual decrease of water balance from 2nd day to 14th day of vase life study of gypsophila cut flowers.

This might be due to decreased water stress which further enhanced protein activity with good water relations in cut flower stem of gypsophila with cobalt chloride at 100 ppm. Further there was less cell membrane destruction and maintained cell membrane stability. These findings are in confirmity with the earlier reports of Hashemabadi (2011) [8].

Fresh weight change (%)

The gypsophila flowers held in different floral preservatives differed significantly. The highest mean values of fresh weight change was observed in the treatment (T_4) Cobalt chloride at100ppm on 2nd day (109.33%), 4th day (107.34%), 6th day (106.21%), 8th day (104.83%) and over all mean value (106.92%) which is at par with (T_5) Cobalt chloride at 200ppm on 2nd day (108.86%), 4th day (107.10%), 6th day (105.80%), 8th day (104.62%) and over all mean value (106.59%) and (T_6) Cobalt chloride at 300ppm on 2nd day (108.42%), 4th day (106.92%), 6th day (105.67%), 8th day (104.17%) and over all mean value (106.29%). However, the treatment, (T_{10}) control (distilled water) recorded significantly lowest values on 2nd day (87.83%), 4th day (85.34%), 6th day (84.25%), 8th day (83.18%) and over all mean (85.15%). The remaining treatments recorded intermediate results and were on par with each other there was gradual decrease of fresh weight change from 2nd day to 14th day of vase life study of gypsophila cut flowers.

This might be due to maximum uptake of water and maintaining good water balance by flowers. The enhanced and continuous water uptake might be responsible for highest fresh weight change. According to De stigter (1980) [3], water uptake and water loss effects the fresh weight change in cut flowers, maximum water status in the flower tissue help to maintain more fresh weight of flowers. Antimicrobial activity of Cobalt chloride and aluminium sulphate might have prevented the blockage of conducting vessels by inhibiting the growth of microbes in vase solution as observed in cut roses Tsegaw *et al*. (2011) [15]. Similar results were earlier reported by Sunanda (2007) [14] in cut carnation flowers, Prasanth (2006) [12] in cut gerbera flowers, and Halevy and Mayak (1978) [7] in rose cut flower.

Physiological loss in weight (%)

The treatments of floral preservative were differed significantly on physiological loss in weight. The lowest mean values of PLW was recorded in (T_4) Cobalt chloride at 100 ppm on 2nd day (6.17%), 4th day (5.20%), 6th day (4.35%), 8th day (3.12%) and over all mean value (4.71%) which is at par with (T_5) Cobalt chloride at 200 ppm on 2nd day (6.34%), 4th day (5.20%), 6th day (5.17%), 8th day (4.23%) and over all mean value (3.16%) and the highest mean values of PLW was recorded in (T_{10}) distilled water (control) on 2nd day (10.35%), 4th day (9.29%), 6th day (8.14%), 8th day (7.32%) and over all mean value (8.78%). The remaining treatments recorded intermediate results and were on par with each other and there was gradual decrease of PLW from 2nd day to 14th day of vase life study of gypsophila cut flowers.

This is attributed to acceleration of water relations that finally caused the increased water uptake and fresh weight of cut flowers. These results are in accordance with earlier reports of Pun and Ichimura (2003) [13] in carnations.

Optical density of vase solution

The gypsophila flowers held in different floral preservatives differed significantly for optical density of vase solution. The treatment, (T_4) Cobalt chloride at 100 ppm recorded significantly lowest values on 2nd day (1.680), 4th day (1.737), 6th day (1.760), 8th day (1.763) and over all mean value (1.735).The treatment (T_{10}) distilled water (control) recorded significantly highest optical density of vase solution 2nd day (1.791), 4th day (1.862), 6th day (1.881), 8th day (1.901) and over all mean (1.858). The remaining treatments recorded intermediate results and were on par with each other and there was gradual increase of OD values from 2nd day to 14th day of vase life study of gypsophila cut flowers.

This might me due to low bacterial count and also maximum water uptake and transpirational loss of water than other treatments. There was a positive correlation between the number of bacteria and water conductivity in the stem of cut flowers. (Van *et al.*, 1991) [16] and antimicrobial action which is attributed to lower turbidity of vase solution. These results were in line with Tsegaw *et al.*, (2011) [15] in cut rose, Bhanumurthy (2013) [2] in cut gerbera, (Knee, (2000) [9] in cut rose cv. Classy.

Vase life of flowers (days)

The gypsophila flowers treated with different floral preservatives differed significantly with regard to vase life in gypsophila. The maximum vase life (13.33 days) was recorded in the treatment (T_4) Cobalt chloride at 100ppm followed by the treatment (T_2) Aluminium sulphate at 200 ppm (12.37 days) and lowest (5.10 days) was recorded in the treatment (T_{10}) control (distilled water). The remaining treatments recorded intermediate results and were on par. Cobalt chloride at 100 ppm and Aluminium sulphate at 200 ppm recorded highest vase life among the floral preservatives tested in the present study. This might b due to the decreased respiration rate as reported by Anjum *et al.* (2001) [1] in tuberose and further, increased cell wall resistance associated with reduced microbial activity was noticed by Nowak and Rundnicki (1990) [11] in cut flowers under the influence of cobalt chloride or aluminium sulphate consequently a higher water uptake was facilitated by preventing the blockage of xylem vessel by these preservatives.

Microbial count in Vase solution (cfu/ml)

The gypsophila flowers treated with different floral preservatives differed significantly regarding the microbial count in vase solution. The lowest was recorded in the treatments (T_4) Cobalt chloride at 100 ppm (6.040×10^{-5}) followed by (T_2) Aluminium sulphate at 200 ppm (6.200×10^{-5}) and highest microbial count was recorded in the treatment (T_{10}) Control (7.580×10^{-5}). The remaining treatments recorded intermediate results and were on par with each other.

This is attributed to inhibition of vascular blockage by Cobalt chloride which has anti-microbial property and thus led to higher water uptake through stems and there by enhanced vase life of cut flowers. These results are in accordance with Elham *et al.*, (2014) [4].

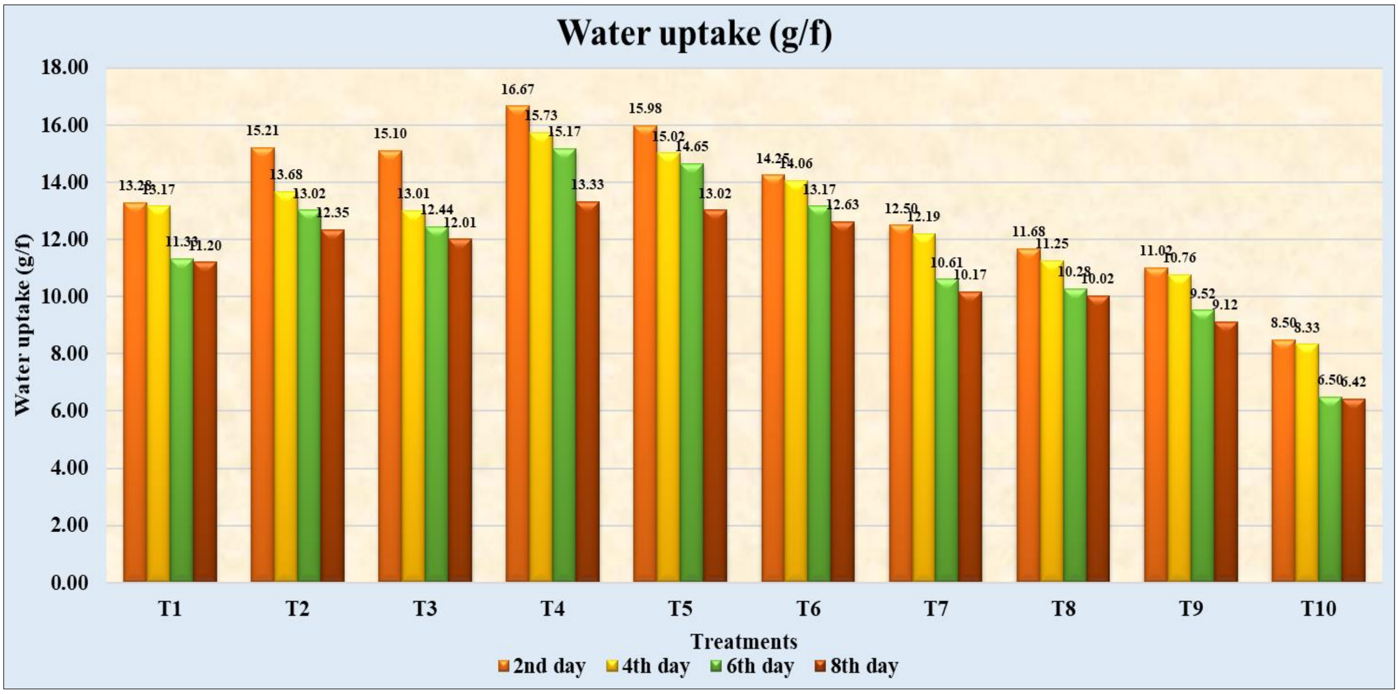

Fig 1: Effect of Floral preservatives on water uptake (g/f) of gypsophila cut flowers cv. Crystal White.

T_1-Aluminium sulphate @ 100 ppm
T_2- Aluminium sulphate @ 200 ppm
T_3- Aluminium sulphate @ 300 ppm
T_4- Cobalt chloride @ 100 ppm
T_5- Cobalt chloride @ 200 ppm
T_6- Cobalt chloride @ 300 ppm
T_7- Sodium benzoate @ 100 ppm
T_8- Sodium benzoate @ 200 ppm
T_9- Sodium benzoate @ 300 ppm
T_{10}- Distilled water (Control)

Table 1: Effect of Floral preservatives on water uptake (g/f) of gypsophila cut flowers cv. Crystal White.

Treatments	Water uptake (g/f)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T_1-Aluminium sulphate @ 100 ppm	13.28 ^{d}	13.17 ^{b}	11.33 ^{d}	11.20 ^{c}	12.24	10.33	9.41	8.32
T_2- Aluminium sulphate @ 200 ppm	15.21^{b}	13.68 ^{b}	13.02 ^{b}	12.35 ^{b}	13.56	11.17	10.20	9.43
T_3- Aluminium sulphate @ 300 ppm	15.10 ^{b}	13.01^{b}	12.44 ^{c}	12.01 ^{b}	13.14	10.51	9.83	8.50
T_4- Cobalt chloride @ 100 ppm	16.67 ^{a}	15.73 ^{a}	15.17 ^{a}	13.33 ^{a}	15.23	11.33	10.83	10.12
T_5- Cobalt chloride @ 200 ppm	15.98 ^{a}	15.02 ^{a}	14.65 ^{a}	13.02 ^{a}	14.67	11.34	10.16	9.33
T_6- Cobalt chloride @ 300 ppm	14.25 ^{c}	14.06 ^{b}	13.17 ^{b}	12.63 ^{a}	13.53	9.78	9.37	9.15
T_7- Sodium benzoate @ 100 ppm	12.50 ^{e}	12.19 ^{c}	10.61 ^{e}	10.17 ^{d}	11.36	-	-	-
T_8- Sodium benzoate @ 200 ppm	11.68 ^{f}	11.25 ^{d}	10.28 ^{e}	10.02 ^{d}	10.81	-	-	-
T_9- Sodium benzoate @ 300 ppm	11.02 f	10.76 ^{d}	9.52 ^{f}	9.12 ^{e}	10.10	-	-	-
T_{10}- Distilled water (Control)	8.50 ^{g}	8.33 ^{e}	6.50 ^{g}	6.42 ^{f}	7.44	-	-	-
S.Em±	0.24	0.26	0.18	0.20		0.15	0.20	0.24
CD (P=0.05)	0.71	0.77	0.54	0.60		0.45	0.59	0.72

Figures bearing same letters did not differ significantly.

Table 2: Effect of Floral preservatives on transpirational loss of water (g/f) during of gypsophila cut flowers cv. Crystal White.

Treatments	Transpirational loss of water (g/f)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T_1-Aluminium sulphate @ 100 ppm	15.82 ^{b}	15.07 ^{b}	14.11 ^{c}	12.62 ^{b}	14.40	12.17	11.33	10.20
T_2- Aluminium sulphate @ 200 ppm	16.01 ^{b}	15.33 ^{b}	15.05 ^{b}	14.01 ^{a}	15.10	13.67	13.50	13.00
T_3- Aluminium sulphate @ 300 ppm	15.89 ^{b}	15.20 ^{b}	14.93 ^{b}	13.00 ^{b}	14.76	13.50	13.00	11.00
T_4- Cobalt chloride @ 100 ppm	17.96 ^{a}	17.33 ^{a}	16.39 ^{a}	15.20 ^{a}	16.72	14.07	13.83	13.30
T_5- Cobalt chloride @ 200 ppm	17.23 ^{a}	16.95 ^{a}	15.83 ^{a}	14.72 ^{a}	16.18	13.33	12.50	11.17
T_6- Cobalt chloride @ 300 ppm	16.89 ^{a}	16.25 ^{a}	15.80 ^{a}	14.27 ^{a}	15.80	13.50	13.16	12.15
T_7- Sodium benzoate @ 100 ppm	15.17 ^{b}	14.12 ^{c}	13.06 ^{d}	12.13 ^{b}	13.43	-	-	-
T_8- Sodium benzoate @ 200 ppm	14.25 ^{c}	13.86 ^{c}	13.57 ^{d}	12.07 ^{b}	13.48	-	-	-
T_9- Sodium benzoate @ 300 ppm	13.34 ^{d}	13.03 ^{d}	12.71^{d}	10.82 ^{c}	12.47	-	-	-
T_{10}- Distilled water (Control)	12.15 ^{e}	11.12 ^{e}	10.17 ^{e}	8.15 ^{d}	10.39	-	-	-
S.Em±	0.28	0.26	0.24	0.33		0.19	0.22	0.18
CD (P=0.05)	0.84	0.77	0.73	0.98		0.57	0.67	0.55

Figures bearing same letters did not differ significantly

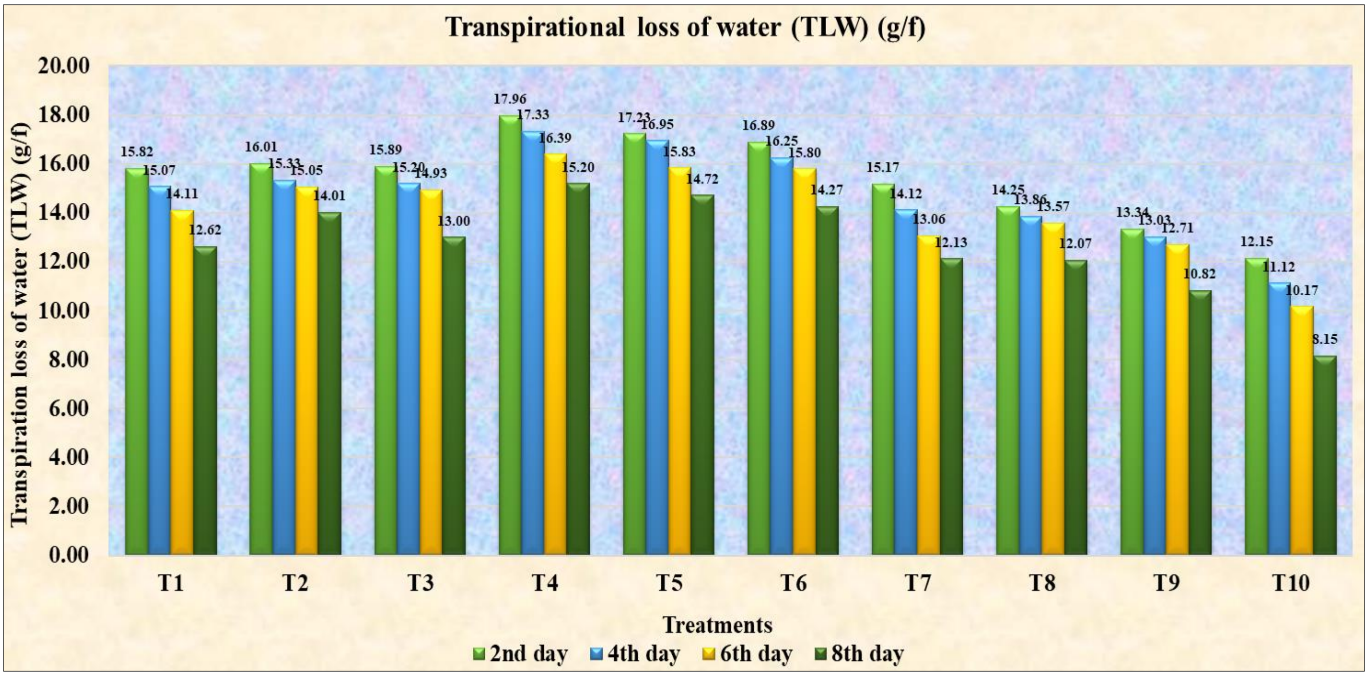

Fig 2: Effect of Floral preservatives on transpirational loss of water (g/f) of gypsophila cut flowers cv. Crystal White.

T_1-Aluminium sulphate @ 100 ppm
T_2- Aluminium sulphate @ 200 ppm
T_3- Aluminium sulphate @ 300 ppm
T_4- Cobalt chloride @ 100 ppm
T_5- Cobalt chloride @ 200 ppm
T_6- Cobalt chloride @ 300 ppm
T_7- Sodium benzoate @ 100 ppm
T_8- Sodium benzoate @ 200 ppm
T_9- Sodium benzoate @ 300 ppm
T_{10}- Distilled water (Control)

Table 3: Effect of Floral preservatives on water balance (g/f) of gypsophila cut flowers cv. Crystal White.

Treatments	Water balance (g/f)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T1-Aluminium sulphate @ 100 ppm	4.750^{c}	3.062 e	3.050^{d}	2.971^{e}	3.460	2.850	2.840	2.820
	(0.750)	(-0.938)	(-0.950)	(-1.029)	(-0.55)	(-1.150)	(-1.160)	(-0.380)
T2- Aluminium sulphate @ 200 ppm	5.100^{a}	3.740^{b}	4.551^{b}	4.340^{b}	4.432	4.460	4.330	4.260
	(1.100)	(-0.260)	(0.551)	(0.340)	(0.432)	(0.460)	(0.330)	(0.260)
T3- Aluminium sulphate @ 300 ppm	4.950^{b}	3.230^{c}	3.171^{c}	2.862^{f}	3.553	2.830	2.760	2.730
	(0.950)	(-0.770)	(-0.829)	(-1.138)	(-0.447)	(-1.170)	(-1.240)	(-1.270)
T4- Cobalt chloride @ 100 ppm	5.521^{a}	4.740^{a}	4.660^{a}	4.440^{a}	4.840	4.470	4.360	4.330
	(1.521)	(0.740)	(0.660)	(0.440)	(0.840)	(0.470)	(0.360)	(0.330)
T5- Cobalt chloride @ 200 ppm	5.489^{a}	4.718^{a}	4.622^{a}	4.430^{a}	4.815	4.380	4.310	4.250
	(1.489)	(0.718)	(0.622)	(0.430)	(0.815)	(0.380)	(0.310)	(0.250)
T6- Cobalt chloride @ 300 ppm	5.473^{a}	4.723^{a}	4.593^{a}	4.398^{a}	4.796	2.840	2.790	2.770
	(1.473)	(0.723)	(0.593)	(0.398)	(0.796)	(-1.160)	(-1.210)	(-1.230)
T7- Sodium benzoate @ 100 ppm	3.150^{d}	3.130^{d}	3.140^{d}	3.110^{c}	3.132	-	-	-
	(-0.850)	(-0.870)	(-0.860)	(-0.890)	(-0.868)			
T8- Sodium benzoate @ 200 ppm	3.141^{d}	3.070^{e}	3.022^{d}	3.010^{d}	3.060	-	-	-
	(-0.859)	(-0.930)	(-0.978)	(-0.990)	(-0.940)			
T9- Sodium benzoate @ 300 ppm	3.080^{e}	3.041^{e}	3.012^{d}	3.002^{d}	3.033	-	-	-
	(-0.920)	(-0.959)	(-0.988)	(-0.998)	(-0.967)			
T10- Distilled water (Control)	2.870^{f}	2.670^{f}	2.560^{e}	2.460^{g}	2.640	-	-	-
	(-1.130)	(-1.330)	(-1.440)	(-1.540)	(-1.360)			
S.Em±	0.014	0.013	0.014	0.012		0.008	0.009	0.013
CD (P=0.05)	0.041	0.039	0.042	0.036		0.024	0.026	0.027

Figures bearing same letters did not differ significantly. Figures with in Parenthesis represents original values. The data were analyzed statistically after uniform addition of a base value 4.0

Table 4: Effect of Floral preservatives on fresh weight Change (%) of gypsophila cut flowers cv. Crystal White.

Treatments	Fresh weight change (%)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T1-Aluminium sulphate @ 100 ppm	106.16^{c}	104.33^{c}	102.17^{c}	101.33^{c}	103.50	98.83	95.17	92.17
T2- Aluminium sulphate @ 200 ppm	108.33^{a}	106.80^{a}	105.92^{a}	104.03^{a}	106.27	102.60	99.17	95.33
T3- Aluminium sulphate @ 300 ppm	107.17^{b}	105.50^{b}	105.14^{b}	103.33^{b}	105.28	102.33	98.33	93.17
T4- Cobalt chloride @ 100 ppm	109.33^{a}	107.34^{a}	106.21^{a}	104.83^{a}	106.92	103.6	100.33	96.33
T5- Cobalt chloride @ 200 ppm	108.86^{a}	107.10^{a}	105.80^{a}	104.62^{a}	106.59	102.33	98.70	94.33
T6- Cobalt chloride @ 300 ppm	108.42^{a}	106.92^{a}	105.67^{a}	104.17^{a}	106.29	101.33	98.17	94.33
T7- Sodium benzoate @ 100 ppm	104.15^{d}	103.19^{d}	102.32^{c}	101.06^{c}	102.68	-	-	-
T8- Sodium benzoate @ 200 ppm	103.12^{e}	102.33^{e}	100.07^{d}	99.34^{d}	101.21	-	-	-
T9- Sodium benzoate @ 300 ppm	102.36^{f}	100.50^{f}	100.23^{d}	97.16^{e}	100.06	-	-	-
T10- Distilled water (Control)	87.83^{g}	85.34^{g}	84.25^{e}	83.18^{f}	85.15	-	-	-
S.Em±	0.18	0.21	0.17	0.16		0.15	0.12	0.11
CD (P=0.05)	0.54	0.64	0.50	0.47		0.44	0.37	0.32

Figures bearing same letters did not differ significantly

Table 5: Effect of Floral preservatives on Physiological loss in weight (%) of gypsophila cut flowers cv. Crystal White.

Treatments	Physiological loss in weight (%)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T1-Aluminium sulphate @ 100 ppm	7.67^{d}	7.33^{c}	6.10^{c}	5.12^{d}	6.55	4.10	3.35	2.31
T2- Aluminium sulphate @ 200 ppm	8.56^{c}	8.14^{b}	6.21^{c}	5.66^{c}	7.14	5.17	4.23	3.11
T3- Aluminium sulphate @ 300 ppm	8.83^{c}	8.21^{b}	6.07^{c}	5.94^{c}	7.26	5.21	3.37	3.26
T4- Cobalt chloride @ 100 ppm	6.17^{e}	5.20^{e}	4.35^{e}	3.12^{f}	4.71	3.33	2.42	1.69
T5- Cobalt chloride @ 200 ppm	6.34^{e}	5.17^{e}	4.23^{e}	3.16^{f}	4.73	4.31	3.90	3.60
T6- Cobalt chloride @ 300 ppm	7.31^{d}	6.24^{d}	5.15^{d}	4.11^{e}	5.70	5.43	4.26	3.15
T7- Sodium benzoate @ 100 ppm	8.30^{c}	7.67^{c}	6.83^{b}	6.36^{b}	7.29	-	-	-
T8- Sodium benzoate @ 200 ppm	9.36^{b}	8.24^{b}	7.12^{b}	6.50^{b}	7.81	-	-	-
T9- Sodium benzoate @ 300 ppm	10.31^{a}	8.67^{b}	7.36^{b}	6.57^{b}	8.23	-	-	-
T10- Distilled water (Control)	10.35^{a}	9.29^{a}	8.14^{a}	7.32^{a}	8.78	-	-	-
S.Em±	0.17	0.18	0.20	0.17		0.14	0.14	0.16
CD (P=0.05)	0.50	0.53	0.61	0.50		0.43	0.43	0.47

Figures bearing same letters did not differ significantly.

Table 6: Effect of Floral preservatives on optical density of vase solution (at 480 nm) of gypsophila cut flowers cv. Crystal White.

Treatments	Optical density of vase solution (480 nm)							
	2nd day	4th day	6th day	8th day	Mean	10th day	12th day	14th day
T_1-Aluminium sulphate @ 100 ppm	1.750 d	1.751f	1.772 d	1.801 b	1.768	1.801	1.825	1.871
T_2- Aluminium sulphate @ 200 ppm	1.770 b	1.740 f	1.768 d	1.780 b	1.764	1.780	1.782	1.790
T_3- Aluminium sulphate @ 300 ppm	1.731 e	1.742 f	1.761 d	1.772 c	1.751	1.781	1.786	1.788
T_4- Cobalt chloride @ 100 ppm	1.680 f	1.737 f	1.760 d	1.763 c	1.735	1.780	1.781	1.761
T_5- Cobalt chloride @ 200 ppm	1.760 c	1.772 e	1.781d	1.790 b	1.775	1.800	1.802	1.811
T_6- Cobalt chloride @ 300 ppm	1.751 d	1.801 d	1.803 c	1.809 b	1.791	1.754	1.760	1.761
T_7- Sodium benzoate @ 100 ppm	1.732 e	1.739 f	1.770 d	1.772 c	1.753	-	-	-
T_8- Sodium benzoate @ 200 ppm	1.760 c	1.810 c	1.852 b	1.882 a	1.826	-	-	-
T_9- Sodium benzoate @ 300 ppm	1.740 e	1.830 b	1.860 b	1.871 a	1.825	-	-	-
T_{10}- (Distilled water) (Control)	1.791a	1.862 a	1.881a	1.901 a	1.858	-	-	-
S.Em±	0.003	0.006	0.005	0.006		0.002	0.002	0.003
CD (P=0.05)	0.009	0.019	0.014	0.018		0.006	0.007	0.010

Figures bearing same letters did not differ significantly

Table 7: Effect of Floral preservatives on vase life (days) of gypsophila cut flowers cv. Crystal White.

Treatments	Vase life of flowers (days)
T_1-Aluminium sulphate @ 100 ppm	11.00 b
T_2- Aluminium sulphate @ 200 ppm	12.37 b
T_3- Aluminium sulphate @ 300 ppm	12.30 b
T_4- Cobalt chloride @ 100 ppm	13.33 a
T_5- Cobalt chloride @ 200 ppm	11.67 b
T_6- Cobalt chloride @ 300 ppm	11.10 b
T_7- Sodium benzoate @ 100 ppm	7.33 c
T_8- Sodium benzoate @ 200 ppm	6.38 d
T_9- Sodium benzoate @ 300 ppm	6.00 d
T_{10}- Distilled water (Control)	5.10 e
S.Em±	0.26
CD (P=0.05)	0.77

Figures bearing same letters did not differ significantly.

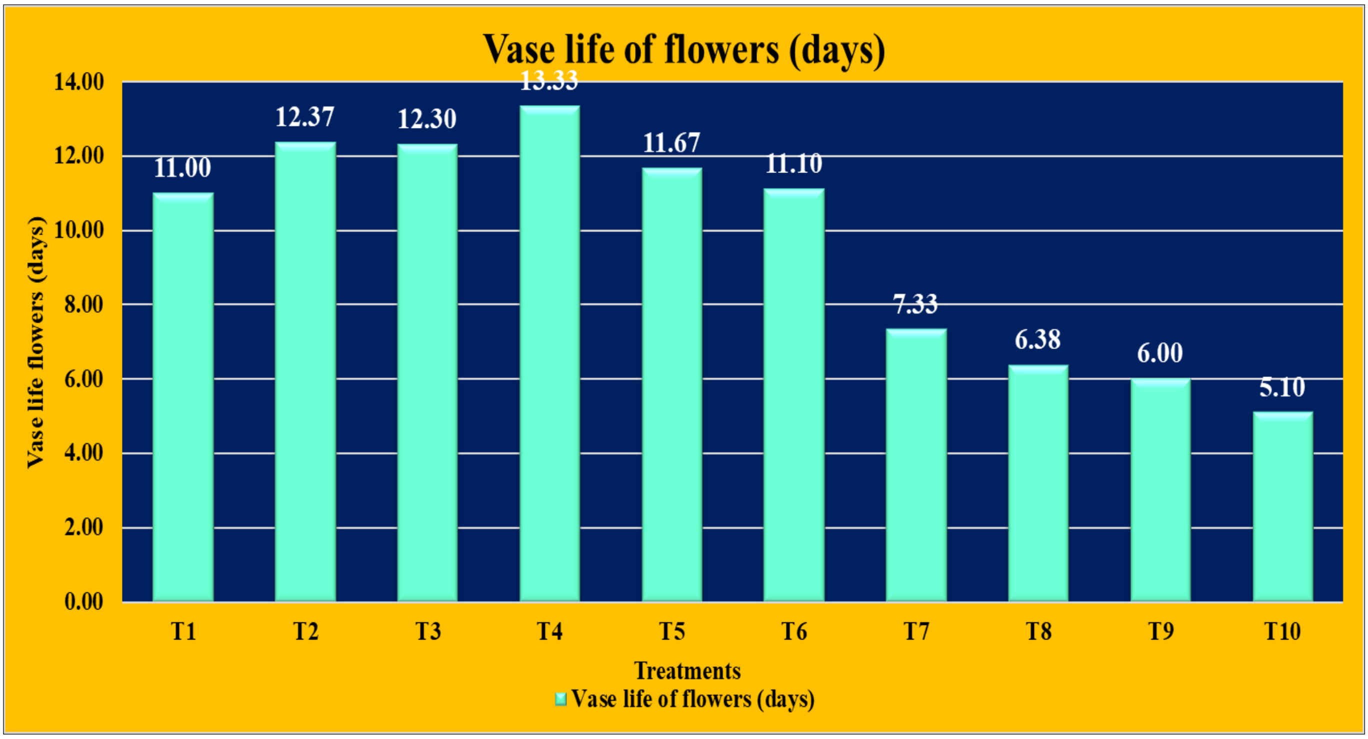

Fig 3: Effect of Floral preservatives on vase life (days) of gypsophila cut flowers cv. Crystal White.

T_1-Aluminium sulphate @ 100 ppm

T_2- Aluminium sulphate @ 200 ppm

T_3- Aluminium sulphate @ 300 ppm

T_6- Cobalt chloride @ 300 ppm

T_7- Sodium benzoate @ 100 ppm

T_8- Sodium benzoate @ 200 ppm

T_4- Cobalt chloride @ 100 ppm
T_5- Cobalt chloride @ 200 ppm
T_9- Sodium benzoate @ 300 ppm
T_{10}- Distilled water (Control)

Table 8: Effect of Floral preservatives on Microbial count in vase solution (CFU/ml) of gypsophila cut flowers cv. Crystal White.

Microbial count in Vase solution (cfu/ml)	
Treatments	**Mean**
T_1-Aluminium sulphate @ 100 ppm	6.190 X 10^{-5} e
T_2- Aluminium sulphate @ 200 ppm	6.200 X 10^{-5} e
T_3- Aluminium sulphate @ 300 ppm	6.150 X 10^{-5} e
T_4- Cobalt chloride @ 100 ppm	6.040 X 10^{-5} f
T_5- Cobalt chloride @ 200 ppm	6.210 X 10^{-5} e
T_6- Cobalt chloride @ 300 ppm	6.320 X 10^{-5} d
T_7- Sodium benzoate @ 100 ppm	6.890 X 10^{-5} b
T_8- Sodium benzoate @ 200 ppm	6.790 X 10^{-5} c
T_9- Sodium benzoate @ 300 ppm	6.780 X 10^{-5} c
T_{10}- Distilled water (Control)	7.580 X 10^{-5} a
S.Em±	0.030
CD (P=0.05)	0.090

Figures bearing same letters did not differ significantly.

Conclusion
Among the different floral preservatives studied that the treatment (T_4) cobalt chloride at 100 ppm was very effective in increasing the vase life of gypsophila flowers (13.33 days). It has led to increased water uptake (15.23 g/f) and water balance (4.840 g/f), optical density (1.737) maximum fresh weight change (106.96%). and recorded low microbial count (6.040 x $10^{-}5$) and is economical though (T_5) cobalt chloride at 200 ppm concentration also recorded higher values which are on par with each other.

References

1. Anjum MA, Farrukh Naveed, Fariha Shakeel, Shazia Amin. Effect of some chemicals on keeping quality and vase life of Tuberose (*Polyanthes tuberosa* L.) cut flowers. Journal of research science. 2001;12(1):01-07.
2. Bhanumurthy KC. Studies on the effect of post-harvest treatments and floral preservatives on extension of vase life of cut gerbera Cv. Savannah. M.Sc. Thesis submitted to Dr. Y.S.R. Horticultural University, West Godavari (A.P), India; c2013.
3. De Stigter HCM. Water balance intack 'Sania' rose plants. Journal of Plant Physiology. 1980;12:131-140.
4. Elham A, Moslem J, Majid R. Effects of daffodil flowers and cobalt - chloride on vase life of cut rose. Journal of Chemical Health Risks. 2014;4(2):1-6.
5. Faragher JD, Mayak S, Tirosh T, Halevy AH. Cold storage of rose flowers: Effects of cold storage and water loss on opening and vase life of 'Mercedes' roses. Scientia horticulturae. 1984 Dec 1;24(3-4):369-78.
6. Gevrenova R, Joubert O, Mandova T, Zaiou M, Chapleur Y, Henry M. Cytotoxic effects of four Caryophyllaceae species extracts on macrophage cell lines. Pharmaceutical biology. 2014 Jul 1;52(7):919-25.
7. Halevy A, Byrne TG, Kofranek AM, Farnham DS, Thompson JF, Hardenburg RE. Evaluation of Postharvest Handling Methods for Transcontinental Truck Shipments of Cut Carnations, Chrysanthemums, and Roses1. Journal of the American Society for Horticultural Science. 1978 Mar 1;103(2):151-5.
8. Hashemabadi D. Final report of research project, Islamic Azad Univ. Rasht, Iran, 2011, 101.
9. Knee M. Selection of biocides for use in floral preservatives. Postharvest Biology and Technology. 2000 Apr 1;18(3):227-34.
10. Korkmaz M, Özçelik H. Economic importance of *Gypsophila* L., *Ankyropetalum fenzl* and *Saponaria* L. (Caryophyllaceae) taxa of Turkey. African journal of Biotechnology. 2011;10(47):9533-41.
11. Nowak J, Rudnicki RM. Post-harvest handling and storage of cut flowers. Florist Greens and Potted Plants, 1990, 214-215.
12. Prashanth P. Studies on the role of physiological and biochemical components with floral preservatives on the vase life of cut gerbera (*Gerbera jamesonii*) cv. Yanara. Ph.D Thesis submitted to Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad; c2006.
13. Pun UK, Ichimura K. Role of sugars in senescence and biosynthesis of ethylene in cut flowers. Japan Agricultural Research Quarterly: JARQ. 2003 Oct 31;37(4):219-24.
14. Sunanda. 2007. Studies on the effect of pre and postharvest handling of techniques on extension of vase life of carnation flowers (*Dianthus caryophyllus* L.) cv. Domingo. Ph.D Thesis submitted to Acharya N.G. Ranga Agricultural University, Hyderabad, India.
15. Tsegaw T, Tilahun S, Humphries G. Influence of pulsing biocides and preservative solution treatment on the vase life of cut rose (*Rosa hybrida* L.) varieties. Ethiopian Journal of Applied Science and Technology. 2011 Nov 20;2(2):1-6.
16. Van Doorn WG, De Striger HCM, De Witter Y, Bookstein A. Microorganisms at the cut surface and in xylem vessels of rose flowers. Journal of Applied Bacteriology. 1991;68:117 - 122.
17. Walker C. At home with flower. *Long meadow publishers*, New York; c1994.