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Effect of Vase Solution on Value Addition and Vase-life of Tinted Tuberose (*Polianthes tuberosa* L.) cv. Prajwal

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Abstract

Flower craft is one of the most flourish and dynamic enterprises in today's world. Tinting or artificial colouring of tuberose may be a potential value addition venture. Tuberose (*Polianthes tuberosa* L.) is a popular cut flower having white coloured fragrant blooms. Postharvest losses in many cut are estimated to be as high as 40% in the absence of floral preservatives. Blockage of vascular bundles due to microorganism proliferation is one of the reasons for cut flower postharvest losses. Therefore in this experiment effect of different biocides on kind and proliferation of microbes in vase solution of tinted tuberose were studied**.** In present experiment five different food dyes were used as tinting agent likes Blue, Apple green, Lemon yellow, Orange red and Rose pink at a concentration of 1%. Therefore an inspection was carried out to study the effect of different biocides (Calcium hypochlorite solution of 750 ppm, Sodium hypochlorite solution of 750 ppm, Benzyl adenine 450 ppm and Naphthalene acetic acid 250 ppm) on value addition and vase-life of tinted tuberose cv. Prajwal. In which flowers remained maximum fresh with higher vase-life in Lemon yellow followed by Rose pink and Apple green. Results suggest that among all chemicals Calcium hypochlorite (750 ppm) was best followed by Sodium hypochlorite (750 ppm), Benzyl adenine (450 ppm) and Naphthalene acetic acid (250 ppm).

Keywords: Biocide, microbial proliferation, vase solution

1. Introduction

Flowers are the wonderful creations of the nature and are one of the most beautiful gifts of nature and they are integral part of human life. In this craft, value addition and postharvest handling methods of cut flowers is a captivating and trilling craft gaining importance now-a-days. The tuberose (*Polianthes tuberosa* L.) is a half-hardy, perennial, bulbous plant belongs to family Agavaceae. Tinting is an important value addition technique in flower crops where colour pigments are absent or light or dull. Colouring inflorescences with edible dyes enhance the visual appeal of these flowers, increase their economic value and aesthetic beautification. For decorative purpose where a particular colour is desired, tinting of white flower is an easy way of obtaining the colour of interest whereas, certified synthetic food colours are less expensive, less hazardous and don't impart an intense and uniform colour to the tinted flowers. Tinting techniques has already been experimented in tuberose (Sambandhamurthy and Appavu., 1980; Kumar et al., 2003; Mekala et al., 2012) and Lady's Lace (Patil and Dhaduk., 2008).

The short vase-life of many cut flowers continues to pose a challenge to the floral craft. Short vase-life of tuberose can be associated with, among other factors, unfavourable water balance i.e. the difference between water uptake and loss. Calcium hypochlorite is an inorganic compound with formula $Ca(ClO)_2$. As a mixture with lime and calcium chloride, it is marketed as chlorine powder or bleaching powder for water treatment and as a bleaching agent. This compound is relatively stable and has greater available chlorine than sodium hypochlorite (liquid bleach). Sodium hypochlorite is practically and chemically distinct from chlorine, but may be converted into it by the addition of acid. Calcium hypochlorite and sodium hypochlorite are very good vase preservative. It was previously used by (Jowkar, 2007). 1-Naphthaleneacetic acid, commonly abbreviated NAA is an organic compound with the formula $C_{10}H_7CH_2CO_2H$. NAA is a plant hormone in the auxin family and is an ingredient in many commercial postharvest horticultural products. It is also a rooting agent and used for vegetative propagation of plant from stem and leaf cutting (Dimitrios et al., 2008; Saifuddin., 2009). 6-Benzyladenine is a synthetic cytokinin that stimulates cell division in plants.

Among other actions, it spurs plant growth, sets blossoms, and improves fruit quality. Benzyl adenine may have delayed primary floret opening because cytokinin and gibberellins are documented to delaying senescence of cut flowers (Salisbury and Ross, 1986). Blockage of vascular bundles due to microorganism proliferation is one of the reasons for cut flower postharvest losses. Microbial contamination of cut tuberose vase solution was mostly due to bacteria such as Streptomyces, negative gram Bacillus, negative gram Cocci. In which Aspergillus and yeasts were the most spread microorganisms. Many post-harvest procedures for cut flowers involve use of various compounds and technologies that inhibit the effects of ethylene reduce respiration or maintain better water relations. Therefore an investigation is carried out to study the effect of different biocides (Calcium hypochlorite, Sodium hypochlorite, Naphthalene acetic acid and Benzyl adenine) on value addition and vase life of tinted tuberose cv. Prajwal.

2. Materials and Methods

The site, where experiment was carried out in the departmental laboratory of Department of Horticulture & Post-Harvest Technology, Palli Siksha Bhavana, Visva-Bharti, Sriniketan during December 2014 to January 2015. Five different food dyes were used as tinting agent in the experiment all in powder form viz, Blue (P_1), Apple green (P_2), Lemon Yellow (P_3), Orange red (P_5) and Rose pink (P_6) respectively in place of Blue, Apple green, Lemon Yellow, Orange red and Rose pink respectively, at a concentration of 1% for all. Four different vase solution like S_1 (Calcium hypochlorite 750 ppm), S_2 (Sodium hypochlorite 750 ppm), S_3 (Benzyl adenine 450 ppm) and S_4 (Naphthalene acetic acid 250 ppm) were used. There were 21 different treatments with three replications in each. Different observation like colour solution uptake, amount of water absorbed during tinting, effect of colour and different vase solution on spike weight, number of flower open, number of flower drop, flower length and flower diameter(3rd number of flower) were taken. Flowers were harvested in the morning between 8.00 and 9.00 am. Flowers were harvested from farmer field with 2-3 flowers open in each spike. Immediately after harvest, the cut ends of the flower stalks were immersed in water. To prepare 1% of colour solution powder of Blue, Apple green, Lemon yellow, Orange red and Rose pink colour of 1 g is mixed in 100 ml of filtrated water. The uniform spikes with 60 cm stalk length with 2–3 florets opening with 3 spikes were put in conical flask containing 100 ml of edible dye solutions. Spikes were removed from colour solution after 6 hours immediately after it put in vase solution. Note: Benzyl adenine was dissolve in ethanol and Naphthalene acetic acid in NaOH. First dissolve benzyl adenine in ethanol and Naphthalene acetic acid in NaOH after that mixed in water. Flasks of 500 ml capacity were used. 200 ml of filtered water used for vase solution. The data were analyzed factorial completely randomized block with two factor colour and solution.

3. Results and Discussion

3.1. Amount of colour solution and vase solution absorbed by tuberose flower (ml spike^{-1})

The different food dyes solutions showed the significant difference for amount of colour solution absorption (Table 1) in zero days. The maximum amount of colour solution absorbed in Rose pink (21.84) followed by Apple green (10.73), Blue (10.63), Lemon yellow (10.13) food dyes, whereas minimum amount of colour solution absorbed in Orange red (9.69). The colour solution absorption also showed significant difference for the vase solution maximum colour absorption occurs in S_1 (13.57) followed by S_2 (12), S_3 (12.27) and lowest in S_4 (11.66). In combination of colour and solution shows significant difference in absorption maximum absorption occurs in P_6S_1 i.e. 26.3 followed by P_6S_2 (23.3), P_6S_3 (21.1), P_6S_4 (16.7), P_1S_2 (11.2), P_2S_3 (11), P_2S_2 (10.9), P_1S_1 (10.6), P_2S_1 (10.6), P_1S_3 (10.5), P_2S_4 (10.4), P_3S_1 (10.3), P_1S_4 (10.2), P_5S_1 (10.1), P_3S_3 (9.8), P_3S_2 (9.6), P_5S_2 (9.6) and minimum 9 in P_5S_3.

The data recorded on water uptake by tuberose flower was significantly affected by different biocide solutions. Control recorded significantly highest water absorption (14.55) followed by Apple green (7.13), Rose pink (6.88), Lemon yellow (6.02), Blue (5.13) and least in Orange red (4.94) on first day. Generally the water absorption decreased from second days to seven days during vase solution. The interaction effect of water uptake between colour and vase solution also showed significant difference. The treatment S_1 recorded significantly highest water uptake on days 1, 2, 3, 4, 5, 6 and 7 (7.44, 3.24, 3.40, 3.40, 1.82 and 0.88 respectively) followed by S_2 (5.99, 3.44, 3.53, 3.53, 1.76, 1.52 and 1.19 respectively), S_3 (5.33, 3.40, 3.48, 3.48, 1.47, 1.01 and 0.92 respectively) and significantly lowest water uptake was observed in S_4 (5.33, 3.36, 2.62, 2.62, 1.09, 0.92 and 0.19 respectively). In combination of colour and vase solution showed significant difference in absorption maximum absorption occurs in P_2S_1 i.e. 10.4 followed by P_6S_4 (8.7), P_3S_1 (8.1), P_5S_3 (8.0), P_6S_2 (7.8), P_6S_1 (7.3), P_2S_3 (7), P_1S_1 (6.7), P_2S_4 (5.8), P_2S_2 (5.3), P_3S_2 (5.3), P_1S_4 (4.9), P_1S_3 (4.1), P_6S_3 (3.8), P_5S_1 (3.8), P_3S_4 (3.6) and minimum in P_5S_2 (3.3) in first day. The highest Water uptake was observed due to effective transportation within the floral stems and reduced stem blockage, which was supported by the findings of Marousky (1969) in cut roses. The findings of De Jong (1978); Mayak (1981) and Dumitras et al. (2002) in different cut flowers and Pand and Santhosh (2004) also reported similar observations in cut gladiolus spike.

3.2. Effect of vase solution on spike weight (g spike^{-1}) of tinted tuberose

Effect of solution on spike weight of tinted tuberose was

Table 1: Amount of colour solution and vase solution absorbed by tuberose flower (ml spike^{-1})

Treatments	0 day	1 Days	2 Days	3 Days	4 Days	5 Days	6 Days	7 Days
Colour								
P_0	-	14.55	2.65	2.21	1.55	1.50	1.46	1.30
P_1	10.63	5.13	4.33	3.07	3.07	1.60	1.59	1.18
P_2	10.73	7.13	4.19	2.85	2.85	2.55	2.06	1.44
P_3	10.13	6.02	4.02	1.83	1.83	1.44	1.00	0.17
P_5	9.69	4.94	2.00	2.57	2.57	0.00	0.00	0.00
P_6	21.84	6.88	2.27	5.97	5.97	2.81	1.93	1.21
SEd±	0.54	0.75	0.60	0.61	0.61	0.49	0.37	0.28
CD (*p*=0.05)	1.08	1.51	1.22	1.22	1.22	1.00	0.75	0.57
Solution								
S_1	13.57	7.44	3.24	3.40	3.40	2.39	1.82	0.88
S_2	12.90	5.99	3.44	3.53	3.53	1.76	1.52	1.19
S_3	12.27	5.33	3.40	3.48	3.48	1.47	1.01	0.92
S_4	11.66	5.33	3.36	2.62	2.62	1.09	0.92	0.19
SEd±	0.61	0.84	0.67	0.67	0.67	0.44	0.33	0.32
CD (*p*=0.05)	1.22	1.69	1.36	1.36	1.36	0.89	0.67	0.64
Colour×Solution								
P_1S_1	10.6	6.7	4.0	3.2	3.2	2.3	1.9	1.3
P_2S_1	10.6	10.4	4.7	3.1	3.1	2.6	1.8	0.7
P_3S_1	10.3	8.1	4.0	1.8	1.8	1.6	1.	0.7
P_5S_1	10.1	4.7	1.2	2.4	2.4	-	-	-
P_6S_1	26.3	7.3	2.3	6.6	6.6	5.5	4.3	1.8
P_1S_2	11.2	4.9	3.7	5.1	5.1	2.0	3.1	2.9
P_2S_2	10.9	5.3	5.3	3.3	3.3	2.2	1.5	1.5
P_3S_2	9.6	5.3	3.7	1.8	1.8	1.8	1.0	-
P_5S_2	9.6	3.3	2.6	3.0	3.0	-	-	-
P_6S_2	23.3	7.8	2.0	4.4	4.4	2.8	1.9	1.6
P_1S_3	10.5	4.1	4.6	2.4	2.4	1.1	0.5	0.6
P_2S_3	11.0	7.0	3.5	3.3	3.3	3.5	3.1	3.6
P_3S_3	9.8	7.1	4.2	1.3	1.3	1.5	1.0	-
P_5S_3	9.0	8.0	1.8	1.3	1.3	-	-	-
P_6S_3	21.1	3.8	2.9	9.0	9.0	1.2	0.5	0.5
P_1S_4	10.2	4.9	5.0	1.6	1.6	1.0	0.9	-
P_2S_4	10.4	5.8	3.2	1.7	1.7	1.9	1.9	-
P_3S_4	10.9	3.6	4.2	2.4	2.4	0.8	0.8	-
P_5S_4	10.1	3.8	3.6	2.3	3.6	-	-	-
P_6S_4	16.7	8.7	3.9	2.7	3.9	1.0	1.0	1.0
SEd±	1.21	1.67	1.34	1.34	1.34	0.98	0.74	0.63
CD (*p*=0.05%)	2.43	3.38	2.71	2.71	2.71	2.0	1.5	1.27

P_0: White; P_1: Blue; P_2: Apple green; P_3: Lemon yellow; P_5: Orange red; P_6: Rose pink; S_1: Calcium hypochlorite 750 ppm; S_2: Sodium hypochlorite 750 ppm; S_3: Benzyl adenine 450 ppm; S_4: Naphthalene acetic acid 250 ppm; In table "-" denote that treatment was lost

Table 2: Effect vase solution on spike weight of tinted tuberose (g)

Treatments	0 day	1 Days	2 Days	3 Days	4 Days	5 Days	6 Days	7 Days
Colour								
P_0	39.71	40.77	37.74	35.88	27.36	31.65	17.33	16.75
P_1	38.33	42.44	38.77	33.66	24.10	22.72	19.26	18.25
P_2	39.32	44.37	41.29	34.10	26.68	22.48	20.00	18.92
P_3	39.29	43.80	38.86	32.55	25.67	21.80	14.08	17.54
P_5	39.31	42.16	39.58	34.23	26.05	21.57	4.67	0.00
P_6	38.81	42.11	39.07	36.63	31.53	24.88	22.67	20.88
SEd±	0.44	0.49	1.35	0.95	0.93	1.01	0.51	1.16
CD (*p*=0.05)	NS	1.01	NS	NS	1.89	NS	1.03	2.36
Solution								
S_1	36.53	43.06	40.34	33.95	27.64	22.92	16.81	14.80
S_2	39.37	41.77	38.44	33.79	25.57	22.55	15.79	15.03
S_3	39.51	43.10	38.93	34.27	25.46	21.59	15.67	14.67
S_4	40.65	43.96	40.34	34.93	28.54	23.69	16.27	15.93
SEd±	0.48	0.56	1.52	1.06	1.04	1.13	0.57	1.04
CD (*p*=0.05)	0.98	1.13	NS	2.14	2.11	2.28	NS	NS
Colour×Solution								
P_1S_1	35.1	42.2	38.9	34.2	23.4	22.1	19.4	18.7
P_2S_1	36.1	45.2	44.6	36.5	29.9	24.0	20.3	20.0
P_3S_1	37.4	46.7	40.9	30.3	27.4	22.2	19.3	18.0
P_5S_1	36.1	39.3	37.6	31.7	23.7	20.6	-	-
P_6S_1	37.9	41.8	39.6	37.0	33.8	25.7	25.0	23.0
P_1S_2	40.5	41.8	40.7	35.3	24.5	23.8	19.5	18.5
P_2S_2	40.0	42.0	42.1	35.4	26.5	23.6	19.8	18.7
P_3S_2	39.0	41.9	36.9	32.6	24.0	21.8	18.7	17.5
P_5S_2	38.5	41.7	34.8	29.8	24.0	20.9	-	-
P_6S_2	38.8	41.5	37.7	35.8	28.9	22.7	21.0	19.5
P_1S_3	39.3	42.2	37.7	34.2	25.2	22.3	18.5	17.5
P_2S_3	40.0	43.5	39.4	30.4	25.7	20.4	20.2	18.8
P_3S_3	39.2	44.1	38.9	33.5	24.2	22.1	19.0	17.8
P_5S_3	40.8	44.3	41.2	37.2	22.2	20.3	-	-
P_6S_3	38.3	41.5	37.4	36.0	30.0	22.8	20.7	19.2
P_1S_4	38.5	43.6	37.7	30.8	23.3	22.7	19.7	18.3
P_2S_4	41.2	44.5	39.0	34.1	24.7	22.0	19.7	18.2
P_3S_4	41.6	44.8	38.8	33.8	27.0	21.0	18.0	16.8
P_5S_4	41.8	43.4	44.6	38.3	34.3	24.5	-	-
P_6S_4	40.2	43.6	41.6	37.7	33.4	28.3	24.0	21.8
SEd±	2.85	2.95	3.03	4.23	4.21	4.55	2.29	2.33
CD (*p*=0.05%)	1.97	2.25	NS	4.28	4.22	NS	2.29	NS

mostly non-significant up to 3rd days (Table 2). The minimum flower weight observed at par with P_0 (40.77) while maximum weight gained by P_2 (44.37) on first day. Spike weight showed the significant difference for food dyes and

solution treatments on first day to seventh days. The highest spike weight recorded in treatment S_4 on day 1, 2, 3, 4, 5, 6 and 7 (43.96, 40.34, 34.93, 28.54, 23.69, 16.27 and 15.93 respectively) followed by S_3 (43.10, 38.93, 34.27, 25.46, 21.59, 15.67 and 14.67 respectively), S_2 (41.77, 38.44, 33.79, 25.57, 22.55, 15.79 and 15.03 respectively) and significantly lowest spike weight observed in S_1 (43.06, 40.34, 33.95, 27.64, 22.92, 16.81 and 14.80 respectively). This might be due to BA at all concentrations decreased the rate of leaf nitrogen degradation of Alstroemeria cut flowers during the study period compared to the control. Cytokinins had been reported to delay senescence by retarding the rate of breakdown of proteins rather than enhancing the rate of protein synthesis (Sacher, 1973). Richmond and Lang (1957) reported that kinetin (cytokinin) prevented accelerated protein loss that was typical to detached leaves.

3.3. Effect of vase solution on number of flower open and drop tinted tuberose (flowers spike^{-1})

Number of flower open per day showed the significant difference for different food dyes from first to third days, where the maximum number of florets opened in Rose pink was 7.08 and minimum flower opened in Blue was 5.0 (Table 3) for first day. Solution showed significant difference for opening of flowers the highest number recorded in treatment S_3 significantly highest on days 1, 2, 3 and 4 (2.27, 6.20, 7.20 and 9.07 respectively) followed by S_4 on days 1, 2, 3 and 4 (1.73, 5.47, 7.13 and 7.73 respectively). S_2 (2.07, 5.67, 6.93 and 7.47 respectively) and significantly lowest flower opening observed in S_1 (1.40, 5.27, 7.07 and 7.27 respectively). While in combination of solution and food dye maximum flower opening occurred in P_6S_2 was 8.3 and minimum for P_5S_4 was 4 for first day.

In different colours minimum flower dropping occurred in P_1 was 1.75 and maximum flower dropping occurred in (Table 3) P_5 that was 5.33. In combination minimum of P_3S_4, flower dropping was 1 on first day and maximum flower dropping occurs in P_3S_4 that was 6.7. Number of flower dropping per day showed the significant difference for different food dyes from fourth to seventh days. Minimum number of florets was dropped in control and Blue (0.89 flowers/spike) whereas maximum number of florets was dropped in 5th days on Orange red (6.56 flower spike^{-1} in Table 3) on 4th days. The maximum number of dropping of flowers recorded in solution S_4 significantly highest on days 4, 5, 6 and 7 (3.47, 10.47, 11.73 and 13.33 respectively) followed by S_3 in days 4, 5, 6 and 7 (3.40, 9.27 , 12.27 and 14.47 respectively), S_2 (2.07, 11.33 and 10.20 and 7.47 respectively) significantly lowest flower dropping was observed in S_1 (3.60, 9.60, 8.87, and 13.60 respectively).

3.4. Flower length and flower diameter (cm)

The flower length of tinted tuberose spikes was seen the significant difference for different food dyes from fourth day onwards (Table 4). Flower length was an important quality parameter when flowers were kept for interior decoration it made the environment pleasant. The maximum flower length was Apple green was 5.42 cm and minimum for pink rose was 5.18 cm. The maximum flowers length recorded on first day for vase solution S_1, S_2, S_4 and S_3 were 4.55, 4.30, 4.29 and 4.28 cm respectively, followed by second days maximum flower length for S_1, S_3, S_2 and S_4 were 5.42, 5.33, 5.31 and 5.28 cm respectively, third day S_4, S_1, S_3 and S_2 (5.03, 4.98, 4.98 and 4.95 cm respectively) and on fourth days maximum flower length in S_3, S_4, S_1 and S_2 (4.56, 4.42, 4.14 and 4.12 cm respectively). The interaction effect of food dyes and solution saw the significant difference for flower length (Table 4).

Flower diameter was increases first two days onwards it was decreases maximum flower diameter was for P_3 (4.32 cm) and minimum flower diameter was for P_5 (4.24 cm). The solution maximum flowers diameter recorded first days were S_1, S_2, S_3 and S_4 (3.61, 3.58, 3.52 and 3.52 cm respectively) followed by second day maximum flower diameter were S_1, S_4, S_3 and S_2 (4.30, 4.27, 4.24 and 4.20 cm respectively), third day S_1, S_3, S_4 and S_2 (3.94, 3.88, 3.86 and 3.82 cm respectively) and on fourth days maximum flower diameter were S_2, S_1, S_3 and S_4 (3.35, 3.20, 3.11 and 2.82 cm respectively). In combination of colour and solution maximum flower diameter for combination P_1S_1 and P_3S_3 were 4.5 cm and minimum for P_5S_1 and P_5S_3 were 4.1 cm (first days).

Lastly it could be concluded that floret length and diameter increases first 2 days after that it decreases. The similar results were observed by Kumar et al. (2003) on postharvest quality of tuberose spikes as affected by colouring agents and storage and Talukdar et al. (2011) on effect of pulsing and different holding solutions on flower quality and vase life of tuberose (*Polianthes tuberosa* L.) cv. Calcutta Double.

3.5. Vase-life of tinted flowers (Days)

Vase-life of tuberose cut spikes showed significant difference for different vase preservatives of food dyes treatments. Maximum vase-life was recorded for control, whereas minimum vase-life was found in sodium hypochlorite 750 concentration. From table number (1 and 2, 3 and 4) it was clear that maximum vase-life recorded for the for vase preservatives of calcium hypochlorite (7 days) whereas minimum vase-life was found in Naphthalene acetic acid. The reason being that water uptake may be the important factor in imprving the length of vase-life of cut flower (Halevy and Mayank., 1979). As the leaves on flower transpire water was dawn up through the xylem. If the process was impeded by a vascular blockage and accelarated by incresesd stomatal opening then transpiration exceed uptake and water deficiency will occur (Van Doorn., 1997). So, solute like calcium hypochlorite was added to vase solutions could decrease

Table 3: Effect of vase solution on number of flower open and drop tinted tuberose (flowers spike^{-1})

Treatments	0 day	1 Days	2 Days	3 Days	4 Days	5 Days	6 Days	7 Days
Colour								
P_0	1.80	5.12	5.66	6.21	3	8.66	12	18.33
P_1	1.83	5.00	6.92	6.42	1.75	8.92	12.58	17.92
P_2	1.67	5.50	6.83	6.50	2.50	7.50	14.17	16.83
P_3	1.75	5.33	6.67	6.08	3.17	6.75	14.50	15.50
P_5	2.00	5.33	7.33	9.92	5.33	19.25	-	-
P_6	2.08	7.08	7.67	10.50	2.92	8.42	12.58	15.50
SEd±	0.25	0.33	0.43	0.54	0.38	1.16	0.52	1.28
CD (*p*=0.05)	0.50	0.66	0.86	1.08	0.78	1.16	1.05	2.60
Solution								
S_1	1.40	5.27	7.07	7.27	3.60	9.60	8.87	13.60
S_2	2.07	5.67	6.93	7.47	2.07	11.33	10.20	14.47
S_3	2.27	6.20	7.20	9.07	3.40	9.27	12.27	11.20
S_4	1.73	5.47	7.13	7.73	3.47	10.47	11.73	13.33
SEd±	0.22	0.36	0.47	0.60	0.43	0.51	0.46	1.15
CD (*p*=0.05)	0.45	0.74	0.96	1.22	0.87	1.03	0.94	2.33
Colour×Solution								
P_1S_1	1.7	5.7	7.3	8.3	2.7	10.0	11.3	15.7
P_2S_1	1.0	5.0	7.7	8.0	3.3	9.0	16.0	19.3
P_3S_1	2.0	6.0	8.0	9.7	3.3	9.7	11.7	18.0
P_5S_1	2.0	5.7	4.0	8.0	5.0	18.7	-	-
P_6S_1	2.0	4.0	9.0	11.3	3.7	9.3	12.0	15.0
P_1S_2	2.0	5.0	6.3	6.0	1.3	9.3	9.3	19.0
P_2S_2	2.0	5.7	6.7	7.0	3.0	6.7	7.7	19.3
P_3S_2	2.0	5.3	7.0	4.0	2.7	5.3	15.7	17.0
P_5S_2	2.0	4.0	8.7	10.3	6.7	19.7	-	-
P_6S_2	2.3	8.3	6.0	9.0	3.3	7.0	11.7	17.0
P_1S_3	2.7	5.3	7.7	6.7	-	5.7	13.7	18.0
P_2S_3	2.3	6.0	6.7	5.7	1.0	6.3	17.3	11.0
P_3S_3	2.0	4.7	5.0	4.3	-	5.0	15.7	11.0
P_5S_3	2.0	7.7	8.7	10.7	7.3	20.3	-	-
P_6S_3	2.3	7.3	7.3	10.0	2.0	9.0	14.7	16.0
P_1S_4	1.0	4.0	6.3	4.7	3.0	10.7	16.0	19.0
P_2S_4	1.3	5.3	6.3	5.3	2.7	8.0	15.7	17.7
P_3S_4	1.0	5.3	6.7	6.3	6.7	7.0	15.0	16.0
P_5S_4	2.0	4.0	8.0	10.7	2.3	18.3	-	-
P_6S_4	1.7	5.7	7.3	8.3	2.7	8.3	12.0	14.0
SEd±	0.49	0.73	0.95	1.20	0.86	1.15	1.04	2.58
CD (*p*=0.05%)	0.99	1.48	1.93	2.43	1.74	2.32	2.11	5.21

Table 4: Effect of colour and concentration on flower length and flower diameter (cm)

Treatments	1 Days		2 Days		3 Days		4 Days	
	Colour							
	L.	D.	L.	D.	L.	D.	L.	D.
P_0	4.26	3.50	5.37	4.17	4.78	4.17	4.41	3.10
P_1	4.36	3.59	5.32	4.27	5.00	4.27	4.31	3.01
P_2	4.40	3.63	5.42	4.27	5.16	4.27	4.39	2.89
P_3	4.42	3.60	5.36	4.32	5.13	4.32	4.36	3.12
P_5	4.37	3.37	5.34	4.14	5.12	4.14	4.45	3.33
P_6	4.33	3.59	5.18	4.27	4.73	4.27	3.96	3.27
SEd±	4.26	0.05	5.37	0.04	4.78	0.04	4.41	0.12
CD (*p*=0.05)	0.03	NS	0.04	0.08	0.04	0.08	0.06	0.24
S_1	4.55	3.61	5.42	4.30	4.98	3.20	4.14	3.20
S_2	4.30	3.58	5.31	4.20	4.95	3.35	4.12	3.35
S_3	4.28	3.52	5.33	4.24	4.98	3.11	4.56	3.11
S_4	4.29	3.52	5.28	4.27	5.03	2.82	4.42	2.82
SEd±	0.04	0.05	0.04	0.04	0.04	0.05	0.06	0.13
CD (*p*=0.05)	0.08	0.11	0.09	0.08	0.08	0.09	0.13	0.27
P_1S_1	4.7	3.7	5.5	4.5	5.2	4.5	4.2	3.1
P_2S_1	4.6	3.7	5.5	4.3	5.1	4.3	4.1	3.2
P_3S_1	4.6	3.5	5.4	4.2	5.1	4.2	4.1	3.2
P_5S_1	4.5	3.5	5.2	4.1	4.9	4.1	3.8	3.0
P_6S_1	4.3	3.7	5.4	4.4	4.7	4.4	4.4	3.6
P_1S_2	4.3	3.7	5.4	4.2	5.1	4.2	4.2	3.2
P_2S_2	4.5	3.5	5.3	4.2	5.1	4.2	4.2	2.8
P_3S_2	4.2	3.6	5.3	4.2	5.1	4.2	4.2	3.5
P_5S_2	4.2	3.3	5.1	4.2	4.7	4.2	3.7	3.8
P_6S_2	4.2	3.7	5.4	4.2	4.8	4.2	4.3	3.4
P_1S_3	4.2	3.6	5.4	4.2	5.1	4.2	4.6	3.0
P_2S_3	4.3	3.7	5.4	4.2	5.2	4.2	4.7	2.7
P_3S_3	4.3	3.6	5.4	4.5	5.2	4.5	4.7	2.9
P_5S_3	4.2	3.2	5.2	4.1	4.7	4.1	4.5	3.7
P_6S_3	4.3	3.4	5.3	4.2	4.8	4.2	4.3	3.3
P_1S_4	4.3	3.5	5.3	4.2	5.2	4.2	4.5	2.8
P_2S_4	4.3	3.6	5.2	4.4	5.1	4.4	4.5	2.8
P_3S_4	4.3	3.6	5.2	4.3	5.2	4.3	4.7	2.9
P_5S_4	4.3	3.4	5.2	4.2	4.7	4.2	3.8	2.8
P_6S_4	4.3	3.5	5.4	4.2	4.9	4.2	4.6	2.8
SEd±	0.07	0.11	0.09	0.08	0.08	0.08	0.13	0.27
CD (*p*=0.05%)	0.15	NS	0.18	NS	0.16	NS	0.26	NS

transpiration or increase water uptake. So flower remains fresh for more days.

4. Conclusion

Tinted spike subjected with different vase solution in which flowers remained maximum fresh with higher vase-life in Lemon yellow followed by Rose pink and Apple green. In different solution calcium hypochlorite was best followed by Sodium hypochlorite, BA then Naphthalene acetic acid on fourth day.

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