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Standardization of tinting techniques in chrysanthemum, tuberose and Lilium

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Abstract
An investigation was carried out to study the vase life, colour intensity, moisture content of tinted chrysanthemum, tuberose and Lilium flowers. The experiment comprised of two factors *i.e.,* first one was flowers treated with six food dyes with 5 per cent concentration along with control and with three different time of immersion for 5.00, 7.50 and 10.00 hrs. The results revealed that flowers treated with food dye blue and immersed for 7.50hrs had recorded higher vase life (7.13 days) in chrysanthemum and flowers treated with distilled water (Control) and immersed for 5.00hrs had recorded the higher vase life (7.00 and 6.13 days) in tuberose and Lilium respectively. Maximum mean moisture content (69.64%) was observed in chrysanthemum flowers treated with yellow dye, immersed for 7.50hrs and tuberose and Lilium flowers treated with distilled water immersed for 5.00hrs (65.73 and 59.76%) respectively. With respect to the colour intensity, colour distribution and consumer acceptability the flowers treated with blue, orange and green dyes which were immersed for about 10hrs duration had recorded the higher consumer acceptance. The flowers which were treated with blue, green and orange (3.00, 3.40 and 3.20hrs) (2.50, 3.00 and 2.55hrs) and (1.15, 1.40 and 1.20hrs) were found to absorb the dyes quickly in chrysanthemum, tuberose and Lilium respectively, Thus it can be concluded that tinting with blue, green and orange which were immersed for 10.00hrs duration had gained the maximum consumer preference with bright attractive flowers.

Keywords: Tinting, chrysanthemum, tuberose and Lilium

Introduction
Tinting is an essential value addition method in flower where the colour pigments are weak or faint. It was a good approach for achieving the desired colour at the post-harvest stage by modifying the colours according to the wish (Ranchana *et al*., 2017) [5]. For aesthetic purposes where a specific colour is required, tinting of white flowers may be the only option to get the desired colour. Tinted flowers often command a premium on the market. Tinting allows you to add one or more colours to cut flowers. Aesthetic beauty may also be achieved via the use of a diverse range of colours. The coloured flowers improve the appearance and attractiveness of the arrangement, as well as the beauty of fresh and dried flowers. In tinting, using dual colours makes it possible to create two colours in a single bloom (Sowmeya *et al*., 2017) [10].
Chrysanthemum, tuberose and Lilium are popular cut flowers, globally these have wide range of bright, vivid and clear coloured flowers, these spectacular eye catching flowers are complement to any kind of flower arrangements (Soni and Godra., 2017) [9]. Tinting in these crops will helps to provide the great variety of colours and these tinted flowers can be effectively utilized in the bouquet preparation, flower arrangement and stage decorations *etc.*, to increase its aesthetic value and appeal.

Materials and Methods
The present investigation was carried out at Department of Post Harvest Technology, KRC College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot.

Collection of fresh flowers
To the present study three flower crops *viz.*, chrysanthemum (*Dendranthema grandiflora*), tuberose (*Polianthes tuberosa* L.) and lilium (*Lilium* spp.) were choosen based on the demand and scope for value addition. White flowered cultivars of these flower species *viz.*, chrysanthemum cv. Arti queen, tuberose cv. Vaibhav and lilium cv. Novana having uniform size, shaped, matured and fresh flowers were collected from the private forms located at

Belagavi, Bangalore and Tumkur were selected with 2 factors *i.e.,* six different colours along with control and three different immersion time.

Tinting of flowers was done by stem absorption method. The collected fresh flowers of chrysanthemum, tuberose and lilium were conditioned by dipping them in solution containing one percent sodium hypochlorite solution overnight, later the conditioned flowers were cut to maintain a uniform length and the basal pair of leaves were removed and slant cut of 45 degree was given at the base in order to make maximum dye absorption. Later these pre - treated flowers were placed in test bottles for the absorption of dye solution. The dyes are used at five percent concentration.

The time taken for absorption of food dyes by cut stems of chrysanthemum, tuberose and lilium was calculated based on the colour change in the flowers and it is expressed in hours. Colour intensity was recorded by using Royal Horticultural Society (RHS) colour chart which was expressed by using the different colour codes. The vase life was determined by recording how many days the flowers remain fresh, wilting of fifty per cent of florets in the spikes was taken as an index of end of vase life of the flower spikes and vase life was recorded in days. Moisture was determined by recording the fresh and dry weight of the florets (Kept in easy drier at 60˚C). Moisture content was expressed in fresh weight basis in percentage.

Results and Discussion

Time taken for colour uptake (Hrs): Among the six colours blue, green and orange had recorded the quicker absorption of dye (3.00, 3.40 and 3.20hrs) (2.50, 3.00 and 2.55hrs) and (1.15, 1.40 and 1.20hrs) with respect to the pink no colour was expressed in chrysanthemum, tuberose and lilium flowers respectively. Different times required to express fully in flowers was dependent on the colour/dye characteristics. Tinting with food dyes recorded better colour uptake as well as colour intensity. Results are in conformity with the observation made by Mekala *et al.,* (2012) [4].

Colour intensity

Visual quality of colours obtained for blue (N110B), green (134B), yellow (2) and pink (55A) with 10.00 hrs of immersion were found more intensified in chrysanthemum. In case of tinted tuberose, the colour codes obtained for blue (N109B), green (134C), yellow (6C), orange (29A) and pink (49B) dyes with 10.00 hrs of immersion were observed more intensified. In tinted flowers of lilium the colours obtained for blue (113A), green (134A), yellow (4A) and pink (54B) dyes with 10.00 hrs of immersion were found superior when compared to other treatments. Colour intensity was found to be best in flowers immersed in dye solution for 10.00 hrs. It was observed that with increasing time of immersion in food dyes increased the colour intensity of the tinted flowers. Because of more time availability for the absorption of the dye solution. Obtained results were in conformity with the findings of Safeena *et al.* (2016) [6].

Table 1: Effect of different tinting treatments on colour intensity in single colour tinted flowers of chrysanthemum, tuberose and Lilium

Treatments	Chrysanthemum	Tuberose	Lilium
$C_1 \times T_1$	NN155C (White)	NN155C (White)	NN155D (White)
$C_1 \times T_2$	NN155C (White)	NN155C (White)	NN155D (White)
$C_1 \times T_3$	NN155C (White)	NN155C (White)	NN155D (White)
$C_2 \times T_1$	N109 C (Brilliant blue)	N109 C (Brilliant blue)	111B (Brilliant greenish blue)
$C_2 \times T_2$	N109 C (Brilliant blue)	N109 C (Brilliant blue)	111B (Brilliant greenish blue)
$C_2 \times T_3$	N110B (Strong blue)	N109 B (Strong blue)	113A (Strong greenish blue)
$C_3 \times T_1$	N155B (Pinkish white)	N155B (White)	NN155D (White)
$C_3 \times T_2$	49C (Light pink)	NN155D (White)	NN155C (White)
$C_3 \times T_3$	56 (Red purplish pink)	NN155D (White)	NN155C (White)
$C_4 \times T_1$	134B (Strong yellowish green)	134C (Brilliant yellowish green)	140B (Brilliant yellowish green)
$C_4 \times T_2$	134B (Strong yellowish green)	134B (Strong yellowish green)	140B (Brilliant yellowish green)
$C_4 \times T_3$	134B (Strong yellowish green)	134C (Brilliant yellowish green)	134A (Vivid yellowish green)
$C_5 \times T_1$	3B (Brilliant greenish yellow)	6C (Brilliant greenish yellow)	3B (Brilliant greenish yellow)
$C_5 \times T_2$	6B (Brilliant greenish yellow)	6A (Brilliant greenish yellow)	3A (Brilliant greenish yellow)
$C_5 \times T_3$	2 (Vivid greenish yellow)	6C (Brilliant greenish yellow)	4A (Brilliant greenish yellow)
$C_6 \times T_1$	28B (Vivid orange)	28B (Vivid orange)	28C (Light orange)
$C_6 \times T_2$	28B (Vivid orange)	28B (Vivid orange)	28B (Light orange)
$C_6 \times T_3$	28A (Vivid orange)	29A (Brilliant orange)	30C (vivid yellowish pink)
$C_7 \times T_1$	73 (Strong purplish pink)	50D (Light oink)	55A (Deep purplish pink)
$C_7 \times T_2$	65A (Moderate purplish pink)	51D (Moderate pink)	54C (Strong pink)
$C_7 \times T_3$	55A (Deep purplish pink)	49B (Moderate pink)	54B (Deep purplish pink)

Vase life (Days)

As evident from the mean values of effective vase life of tinted flowers indicated that, there was decreasing in trend in the freshness of tinted flowers. In case of chrysanthemum (Table 2), the maximum vase life was recorded by control (6.75 days) and the lowest was found in the pink colour tinted chrysanthemum flowers (5.25 days). Among the different time of immersion maximum vase life was recorded by T_1 (6.41 days) and minimum was noticed in T_3 (5.68 days). In the interaction effect maximum vase life was recorded in the blue tinted chrysanthemum flower which was immersed for 7.50hrs (7.13 days) and the lowest was recorded in the flowers which were treated with pink colour and immersed for 7.50hrs (4.38 days).

In tuberose (table 2), maximum vase life was recorded by C_1 (6.63 days) and the minimum was found in the C_4 (4.54 days). With respect to different time of immersion maximum vase life was recorded in T_1 (5.83 days) whereas, minimum was noticed in T_3 (4.63 days). In the interaction effect higher vase life was found in control flowers which were immersed for 5.00hrs (7 days) and the lowest vase life was recorded in the flowers which were immersed for 10.00hrs in green colour (4 days). With respect to lilium (Table 2), the maximum vase life of 5.67 days was recorded by C_1 and C_2 and the minimum vase life was noticed by C_3 (4.17 days) among the different colours. Among different time of immersion, maximum vase life was recorded by T_1 (5.51 days) whereas, minimum was noticed in T_3 (4.82 days). In the interaction effect higher vase life was found in control treatments which were immersed for about 5.00hrs (6.13 days) and the lowest vase life was recorded in the flowers which were immersed for 10.00hrs in pink colour (3.88 days).

It was found that higher the absorption of dyes, lower would be the vase life of the tinted flowers. Decreased vase life was due to accelerated ion leakage (Singh *et al.*, 2009) [8]. The edible dyes used in the experiment alter the cell metabolism. Hence certain barriers were formed which restricts for the movement of water and food materials. Therefore osmotic pressure of the cell would be affected thus altering the cell turgidity. The obtained results may also be due to the fact that higher water absorption maintained better water balance and flowers freshness, saves from early wilting and enhances vase life. These results were in accordance with Varu and Barad (2010) [11] in tuberose cv. Double, Awadhesh and Bhagwan (2013) [1], Sneha *et al.* (2019) [7] and Mekala *et al.* (2012) [4] in tuberose.

Table 2: Effect of different tinting treatments on vase life of chrysanthemum, tuberose and lilium

	Chrysanthemum				Tuberose				Lilium			
Treatments	**T_1**	**T_2**	**T_3**	**Mean**	**T_1**	**T_2**	**T_3**	**Mean**	**T_1**	**T_2**	**T_3**	**Mean**
C_1 – Control	7.00	6.88	6.38	6.75	7.00	6.88	6.00	6.63	6.13	5.50	5.38	5.67
C_2 – Blue	6.75	7.13	6.25	6.71	5.65	5.13	4.50	5.09	6.00	5.50	5.50	5.67
C_3 – Pink	6.00	4.38	5.38	5.25	4.88	4.38	4.63	4.63	4.38	4.25	3.88	4.17
C_4 – Green	6.25	5.63	5.63	5.83	5.13	4.50	4.00	4.54	5.83	5.13	3.88	4.94
C_5 – Yellow	6.25	6.00	5.38	5.88	6.00	5.38	4.38	5.25	4.88	4.25	5.13	4.75
C_6 – Orange	6.63	5.63	5.13	5.79	6.13	5.63	4.50	5.42	5.38	5.38	4.88	5.21
C_7 – Red	6.00	5.50	5.63	5.71	6.00	4.88	4.38	5.08	6.00	5.38	5.13	5.50
Mean	6.41	5.88	5.68	5.99	5.83	5.25	4.63	5.23	5.51	5.05	4.82	5.13
	S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%	
C	0.11		0.32		0.09		0.26		0.12		0.34	
T	0.07		0.21		0.06		0.17		0.08		0.22	
C × T	0.19		0.56		0.16		0.46		0.17		0.50	

Factor 1: Colours (C)		**Factor 2: Time of immersion**	
C_1 – Control	C_3 – Pink	C_5 – Yellow	T_1- 5.00hrs
C_2 – Blue	C_4 – Green	C_6 – Orange	T_2- 7.50hrs
		C_7 – Red	T_3 -10.00hrs

Moisture (%)

There was a decreasing trend in moisture content of tinted flowers as the vase life proceeds. Among the seven different treatments the control treatment recorded the highest moisture content of about 69.29 per cent and the lowest of about 58.27 per cent recorded in orange colour (Table 3) at 3DAT, with respect to time of immersion, the highest moisture was found in flowers immersed in dyes for 5.00 hrs (66.91%) and the lowest was found in flowers which were immersed in dyes for 7.5 hrs (65.67%). In the interaction effect due to use of different colours and different time of immersion tested the highest moisture content was found in yellow colour tinted flowers which were immersed for 5 hrs (71.42%) and the lowest was found in orange colour tinted flowers which were immersed in dye solution for 7.5hrs (53.58%) in chrysanthemum.

In tuberose, control treatment recorded the highest moisture content of about 65.49 per cent and the lowest of about 57.27 per cent in pink colour. With respect to time of immersion, the highest moisture was found in flowers immersed in dyes for 7.50hrs (61.70%) and the lowest was found in flowers which were immersed in dyes for 10.00hrs (60.05%). In the interaction effect due to use of different colours and different time of immersion tested the highest moisture content was found in control flowers which were immersed for 5.00hrs (65.70%) and the lowest was found in pink colour tinted flowers which were immersed in dye solution for 10.00hrs (Table 4).

With respect to lilium, control treatment recorded the highest moisture content of about 56.79 per cent and the lowest of about 34.14 per cent in pink colour, with respect to time of immersion, the highest moisture was found in flowers immersed in dyes for 5.00hrs (44.79%) and the lowest was found in flowers which were immersed in dyes for 10.00hrs (34.71%). However, in the interaction effect due to use of different colours and different time of immersion tested the highest moisture content was found in control flowers which were immersed for 5.00hrs (61.70%) and the lowest was found in pink colour tinted flowers which were immersed in dye solution for 10.00hrs (Table 5).

Wilting of tinted flowers occurred due to the declined relative water content (RWC) and due to loss in membrane integrity as a result of loss of turgor pressure of cells (Halevy and Mayak, 1981) [3]. Reduced moisture levels which in turn causes the dehydration of petals due to the faster rate of senescence which in turn causes the wilting and abscission of the petals. These obtained results were in accordance with the reports of Doorn and Woltering (2004) [2], Yamini (2016) [12] and Sneha *et al.* (2019) [7].

Table 3: Effect of different tinting treatments on moisture content (%) in chrysanthemum

Treatments	Days after tinting											
	1				3				6			
	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean
C_1	76.68(8.76)	72.65(8.52)	69.95(8.36)	73.09(8.55)	68.95(8.30)	70.07(8.37)	68.85(8.30)	69.29(8.32)	39.98(6.32)	57.93(7.61)	49.41(7.03)	49.11(6.99)
C_2	76.56(8.76)	71.75(8.69)	70.75(8.41)	73.02(8.54)	71.96(8.48)	63.11(7.94)	71.17(8.44)	68.75(8.29)	54.96(7.41)	52.42(7.24)	54.90(7.41)	54.09(7.35)
C_3	72.42(8.51)	69.97(8.37)	73.42(8.57)	71.54(8.45)	66.10(8.13)	63.83(7.99)	70.08(8.37)	66.67(8.16)	42.64(6.53)	0.00(0.71)	0.00(0.71)	14.21(2.18)
C_4	68.67(8.29)	73.19(8.55)	72.83(8.53)	71.94(8.48)	70.47(8.39)	69.07(8.31)	65.09(8.07)	68.21(8.26)	53.94(7.34)	0.00(0.71)	0.00(0.71)	17.98(2.45)
C_5	69.97(8.37)	72.10(8.49	72.60(8.52)	71.56(8.46)	69.26(8.32)	71.42(8.45)	60.65(7.79)	67.11(8.19)	53.01(7.28)	65.39(8.09)	0.00(0.71)	39.47(5.12)
C_6	75.54(8.69)	68.45(8.27)	76.47(8.74)	73.49(8.57)	59.15(7.69)	53.58(7.32)	62.08(7.88)	58.27(7.63)	44.92(6.70)	0.00(0.71)	0.00(0.71)	14.97(2.23)
C_7	71.97(8.48)	69.81(8.36)	74.70(8.64)	72.16(8.49)	59.71(7.73)	68.59(8.28)	70.51(8.40)	66.27(8.14)	50.6(7.11)	0.00(0.71)	0.00(0.71)	16.87(2.37)
Mean	73.12(8.55)	71.13(8.43)	72.96(8.54)		66.91(8.18)	65.67(8.10)	66.52(8.15)		48.58(6.96)	25.11(3.28)	14.90(2.06)	
	S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%	
C	0.02		0.06		0.013		0.05		0.01		0.04	
T	0.01		0.04		0.008		0.03		0.007		0.03	
C × T	0.03		0.11		0.023		0.09		0.018		0.07	

Factor 1: Colours (C)		Factor 2: Time of immersion	
C_1 – Control	C_3 – Pink	C_5 – Yellow	T_1- 5.00 hrs
C_2 – Blue	C_4 – Green	C_6 – Orange	T_2- 7.50 hrs
		C_7 – Red	T_3 -10.00 hrs

0: Wilting of flowers, Values in the parentheses are indicates square root transformed data

Table 4: Effect of different tinting treatments on moisture content (%) in tuberose

Treatments	Days after tinting											
	1				3				6			
	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean
C_1	90.75(9.53)	91.65(9.57)	91.50(9.57)	**91.30(9.56)**	65.70(8.11)	65.70(8.11)	65.08(8.07)	**65.49(8.09)**	40.75(6.38)	39.68(6.30)	38.92(6.24)	**39.79(6.31)**
C_2	90.00(9.49)	89.10(9.44)	88.12(9.39)	89.08(9.44)	59.10(7.69)	60.58(7.78)	59.27(7.70)	59.65(7.72)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_3	88.14(9.39)	87.50(9.35)	87.25(9.34)	87.63(9.36)	57.75(7.60)	58.05(7.62)	56.00(7.48)	57.27(7.57)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_4	89.55(9.46)	88.10(9.39)	88.23(9.39)	88.63(9.41)	61.20(7.82)	62.15(7.88)	60.25(7.76)	61.20(7.82)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_5	90.75(9.53)	90.87(9.53)	89.12(9.44)	90.25(9.50)	62.10(7.88)	62.00(7.87)	60.10(7.75)	61.40(7.84)	38.80(6.23)	0.00(0.71)	0.00(0.71)	12.93(2.08)
C_6	87.91(9.38)	88.40(9.40)	87.17(9.34)	87.83(9.37)	63.18(7.95)	62.27(7.89)	60.00(7.75)	61.82(7.86)	39.93(6.32)	0.00(0.71)	0.00(0.71)	13.31(2.11)
C_7	89.72(9.47)	88.10(9.39)	88.42(9.40)	88.75(9.42)	62.17(7.89)	61.17(7.82)	59.65(7.72)	61.00(7.81)	40.20(6.34)	0.00(0.71)	0.00(0.71)	13.40(2.11)
Mean	89.55(9.46)	89.10(9.44)	88.55(9.43)		61.60(7.85)	61.70(7.85)	60.05(7.75)		22.81(3.61)	5.67(0.90)	5.56(0.89)	
	S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%	
C	0.012		0.05		0.009		0.04		0.009		0.03	
T	0.008		0.03		0.006		0.02		0.006		0.02	
C × T	0.021		0.08		0.016		0.07		0.015		0.06	

Factor 1: Colours (C)		Factor 2: Time of immersion	
C_1 – Control	C_3 – Pink	C_5 – Yellow	T_1- 5.00 hrs
C_2 – Blue	C_4 – Green	C_6 – Orange	T_2- 7.50 hrs
		C_7 – Red	T_3 -10.00 hrs

0: Wilting of flowers, Values in the parentheses are indicates square root transformed data

Table 5: Effect of different tinting treatments on moisture content (%) in lilium

Treatments	Days after tinting											
	1				3				6			
	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean	T_1	T_2	T_3	Mean
C_1	85.67(9.26)	84.00(9.17)	82.15(9.06)	83.94(9.16)	61.70(7.85)	58.01(7.62)	50.68(7.12)	56.79(7.53)	31.89(5.65)	0.00(0.71)	0.00(0.71)	10.63(1.88)
C_2	84.00(9.17)	82.70(9.09)	81.80(9.04)	82.80(9.10)	41.88(6.47)	38.69(6.22)	35.86(5.99)	38.81(6.23)	28.90(5.38)	0.00(0.71)	0.00(0.71)	9.63(1.79)
C_3	84.20(9.18)	82.00(9.06)	81.70(9.04)	82.70(9.09)	38.38(6.20)	34.10(5.84)	29.94(5.47)	34.14(5.84)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_4	81.94(9.05)	82.68(9.09)	82.15(9.06)	82.26(9.07)	41.74(6.46)	36.85(6.07)	32.79(5.73)	37.13(6.09)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_5	84.60(9.20)	83.21(9.12)	82.10(9.06)	83.30(9.13)	43.21(6.57)	36.53(6.04)	32.18(5.67)	37.31(6.10)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_6	83.62(9.14)	84.50(9.19)	82.80(9.10)	83.64(9.15)	43.71(6.61)	33.18(5.76)	30.50(5.52)	35.80(5.96)	0.00(0.71)	0.00(0.71)	0.00(0.71)	0.00(0.71)
C_7	85.05(9.22)	84.05(9.17)	82.75(9.10)	83.95(9.16)	42.90(6.55)	34.89(5.91)	31.03(5.57)	36.27(6.01)	29.50(5.43)	0.00(0.71)	0.00(0.71)	9.83(1.81)
Mean	84.16(9.17)	83.31(9.13)	82.22(9.07)		44.79 (6.67)	38.89 (6.21)	34.71 (5.87)		12.90 (2.35)	0.00 (0.71)	0.00 (0.71)	
	S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%		S.Em±		C.D. @ 1%	
C	0.02		0.07		0.02		0.07		0.009		0.04	
T	0.01		0.04		0.01		0.05		0.006		0.02	
C × T	0.03		NS		0.03		0.13		0.06		0.015	

Factor 1: Colours (C)		Factor 2: Time of immersion	
C_1 – Control	C_3 – Pink	C_5 – Yellow	T_1- 5.00 hrs
C_2 – Blue	C_4 – Green	C_6 – Orange	T_2- 7.50 hrs
		C_7 – Red	T_3 -10.00 hrs

0: Wilting of flowers, NS: Non significant, Values in the parentheses are indicates square root transformed data

Conclusion

Flowers treated with blue, green and orange which were immersed for 10.00hrs were found better with regard the colour intensity, colour distribution which results in the formation of bright coloured attractive flowers and maximum consumer acceptability.

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