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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 798-801

www.thepharmajournal.com
Received: 08-08-2023
Accepted: 12-09-2023

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To study the effect of tinting and vase solution on vase life of gladiolus (*Gladiolus* sp.)

Amritpal Kaur and Jujhar Singh

Abstract
The present investigation entitled "To study the effect of tinting and vase solution on vase life of gladiolus" was carried out in Mata Gujri College, Fatehgarh Sahib (Punjab), during 2021-22 and 2022-23 to find out the effect of tinting and vase solution on vase life of gladiolus (*Gladiolus* sp.).We used three different food colours -Lemon-yellow, pink, and green with five different preservative solutions for gladiolus *viz*. 2% sucrose + 300 ppm citric acid, 2% sucrose + 400 ppm citric acid, 2% sucrose+ 200 Aluminum sulphate, 2% sucrose + 300 Aluminum sulphate, Control (Distilled water) for two durations *viz*. 2:30 hours and 3:30 hours. The data recorded on different parameters were to statistical analysis with Factorial CRD. From the above studies, it could be concluded that the maximum vase life (25.66) was recorded in $T_2C_1D_1$ i.e., (2% sucrose + 400 ppm citric acid in lemon yellow colour for 2:30 hours) whereas the minimum vase life (16.66) was found in $T_5C_3D_2$ i.e., (Control (Distilled water) in pink colour for 3:30 hours) for gladiolus flower. When the flower is treated with 2% sucrose + 400 ppm citric acid is the most desirable preservative for increasing the vase life of the flower. Among edible food colours, spikes were tinted with lemon yellow colour developed a more uniform colour on florets of gladiolus. The lemon-yellow colour was found to be the best absorption colour on the flower spike for 2:30 hours.

Keywords: Gladiolus, tinting, vase life

Introduction
Gladiolus (*Gladiolus* sp.), which is grown for cut flower production commercially, holds a prominent place among the various flower crops grown around the world. Common names for it include gladioli, corn flag, and sword lily, and it is regarded as "King of bulbous blossom ". It is grown for cut flowers as well as in herbaceous borders, beds, rockery, and pots. Due to its unrivalled beauty and high economic value, gladiolus has become increasingly popular throughout the world. (Satapathy *et al*., 2016) [19]. Tinting can be done by either dipping flower heads in the dye solution e.g., in daisies or by stem absorption e.g., in carnations, gerberas, tuberose, roses, and gladiolus. (K.B. Bijay *et al*., 2020) [2]. Food colours or dyes are used for tinting or artificial colouring. Tinting is an excellent approach for changing the colour of the crop after harvest to suit our preferences. To raise the demand for cut flowers, tinting enables you to add one or more colours. The usage of a wide variety of colours can also create aesthetic attractiveness. The arrangement's look and attractiveness are enhanced by the coloured flowers, which also enhance the beauty of the fresh and dried flowers. Utilizing dual colours in tinting enables the creation of two colours in a single bloom. (Sowmeya *et al*. 2017) [21]. Vase life is one of the prominent factors to keep fresh quality of cut flowers, and it may vary among gladiolus. There are several techniques used to extend the vase life of cut flowers and keep them fresh for extended periods of time. (Hardenburg 1968) [9].

Materials and Methods
The experiment was conducted at Laboratory of Department of Floriculture and Landscape Architecture, Department of Agriculture, Mata Gujri college, Fatehgarh Sahib, Punjab. The experiment was laid out in factorial CRD with 3 food dyes namely Lemon yellow, Apple green, and Pink for two durations with 5 treatment combination of preservative such as 2% sucrose + 300 ppm citric acid, 2% sucrose + 400 ppm citric acid, 2% sucrose+ 200 Aluminum sulphate, 2% sucrose + 300 Aluminum sulphate and Control (Distilled water). After tinting by stem absorption method, the spikes were transferred to glass bottles containing 200 ml of preservative solution to study the vase life. The uniform spikes with 60 cm stalk length with 2-3 florets opening put in conical flask with edible dyes solutions. Spikes were removed from colour solution after 2:30 hours and 3:30 hours immediately after it put in vase solution.

The vase life was studied by recording bud opening, Quantity of solution uptake (ml.), weight loss(g) and vase life (days) for gladiolus flower.

Results and Discussion

Bud Opening

In the gladiolus flower, the maximum days (5.61) taken for bud opening were taken in the treatment of T_2 i.e., (2% sucrose + 400 ppm citric acid). The maximum days taken for bud opening were observed in sucrose provides energy for growth and accelerated the opening of buds. There is a large amount of respiratory substrate (sucrose) available, which assures that young florets open and more solutes might be found transfer through the xylem. The finding is closely related to Baidya and Suhrita, 2020 [2].

In gladiolus, the maximum days (4.95) for bud opening were taken by C_2 (green colour). Tinting with pink colour results into early bud opening because pink colour is a combination of blue and red wave length and these colours are important for plant growth and has a specific effect on bud opening. Our finding are closely related to Vehniwal *et al* 2019 [23].

The interaction between colour and duration result in early bud opening maximum days (6.23) for bud opening was found in C_1D_1 i.e., (Lemon yellow colour for 2:30 hours). Different colours have different effects on various plant processes which includes photosynthesis and flowering. Lemon yellow colour has a positive effect on bud opening. Jyothi *et al.*, (2022) [11] also reported that lemon yellow colour was best for tinting.

In gladiolus, the interaction between treatment x duration, minimum days (3.83) for bud opening was taken in T_1D_3 i.e., (2% sucrose + 300 ppm citric acid for 3:30 hours). Citric acid, among other organic acids, has reportedly been used in the respiratory cycle and other metabolic pathways as a source of carbon and energy for cells. Therefore, it promotes bud opening. Sucrose provides energy for growth and accelerates the opening of buds. Similar results as observed by Silva (2003) [6].

In gladiolus, the interaction between treatment x colour, maximum days (7.41) to bud opening was found in treatment T_2C_1 (2% sucrose + 400 ppm citric acid and in Lemon yellow). Early bud opening was found in sucrose because carbohydrates are necessary for the growth of flower buds in order for them to open. Since they provide carbon skeletons and structural materials that allow for bud opening. On the other side, Aluminium sulphate lowers the pH of the solution which results in the availability of nutrients Similar findings were observed by Pun and Ichimura (2003) [10] in Rose. The interaction between treatment x colour x duration, Early bud opening (2.66 days) was found in $T_5C_3D_2$ i.e., (Control, pink colour, 3:30 hours). Tinting with pink colour results into early bud opening because pink colour is combination of blue and red wavelength and these colours are important for plant growth and has specific effect on bud opening. On the other hand, control (distilled water) and duration of 3.30 hours negatively effect on bud opening.

Solution uptake (ml)

It was observed that the maximum solution was uptake (48.47 ml) was recorded in treatment T_2 i.e., (2% sucrose +400 ppm citric acid). Highest solution uptake with citric acid and sucrose because due to its impact on the stomatal closure and decreased water loss, sucrose increases the water balance in cut flowers (Marousky, 1971) [26]. Similar findings in cut carnation flowers were reported by Luo *et al*. in 2003 [15] and Aryal *et al*. 2019 [1] in Rose.

In the case of colour**,** the maximum solution uptake (47.86 ml) was observed in C_2 i.e., (Green colour). In green colour maximum solution uptake due to the reason yellow, and green colour in the flower due to the presence of carotenoid pigments. Similar outcomes as stated by Vehniwal *et al* 2019 [23].

In the interaction between treatment x colour maximum solution uptake (50.41) was found to be in T_2C_1 i.e., (2% sucrose + 400 ppm citric acid in Lemon yellow). The significant change in solution intake may be caused by osmotic pressure within the cell, which changes the turgidity of the cell thus affecting the amount of water absorbed. (Chougala *et al*., 2016) [3]

In the interaction between colour x duration maximum solution uptake (49 ml) was noticed in C_1D_1 i.e., (Lemon yellow for 2:30 hours). The increase in dye uptake with increase in immersion time has also reported in different floral crops Similar findings were observed by Yamini (2016) [25].

The interaction between treatment x duration show that the maximum solution uptake (49.77 ml) was recorded in T_2D_1 i.e., (2% sucrose + 400 ppm citric acid for 2: 30 hours). The spike was immersed in a solution of sucrose and citric acid. This might be a result of these compounds' ability to avoid vascular obstruction, which would otherwise result in increased dye movement. A similar result was founded by Varu and Barad 2010 [22] in tuberose flowers.

In the interaction between treatment x colour x duration of the maximum solution uptake (50.66 ml) was recorded in $T_2C_1D_1$ i.e., (Lemon yellow colour with 2% sucrose + 400 ppm citric acid for 2:30 hours). The spike was immersed with sucrose and citric acid irrespective of the type of dye. Spikes immersed in dye solution for two hours absorb more dye, which accounts for the spikes' decreased water absorption. This may be due to osmotic pressure, which controls the amount of water that can pass through the stem from the vase solution. Additionally, citric acid showed its advantages in reducing vascular obstruction by causing all coloured spikes treated with sucrose and citric acid to absorb more water. (Gupta and Jhanji 2020) [8]

Weight loss

Among treatments, the maximum weight loss (14.5 g) was recorded in the treatment T_1 i.e., (2% sucrose + 300 ppm citric acid). Sucrose greatly improved the keeping quality by preserving the spike's fresh weight by reducing physiological weight loss, which may be mostly related to greater water retention. According to research by Divya *et al*, (2004) [7] in Rose, sucrose acts as an oxidizable respiratory substrate and an anti-desiccant, increasing the fresh weight of cut flowers.

In case of colour, maximum weight loss (13.9 g) was recorded in C_2 i.e., (Green colour). This might be due to the reason that different colours depending on the colour characteristics have taken different timings for tinting. Similar results were recorded by Kumari *et al.* (2018) [14] in tuberose.

The effect of the interaction gladiolus flower between treatment x colour maximum weight loss (21.41 g) was noticed in treatment T_2C_1 i.e., (2% sucrose + 300 ppm citric acid with lemon yellow colour). The high concentration of dye inside the cell and the likely high concentration of sucrose

in the vase solution may have contributed to the reduced weight by affecting the metabolism and the osmotic pressure of the cells, which changes cell turgidity. Similar result was found by Kumari *et al* 2018 [14].

In the interaction between colour x duration of the maximum weight loss (15.03 g) was observed in C_1D_1 i.e., (Lemon yellow colour for 2:30 hours). Hence, when adding spikes of flower in dye solution for 2:30 hours immersion time resulted that maximum weight loss. Viradia *et al*. (2015) [24] observed the same finding of increased concentration of food dye with higher absorption time in tuberose cv. Double.

In the interaction between treatment x colour x duration of the maximum weight loss (20.66) was found in $T_2C_1D_1$ i.e., (2% sucrose + 400 ppm citric acid for 2:30 hours). Maximum weight loss noted in sucrose and citric acid with a lemon yellow colour for 2:30 hours this could be a result of the spikes' initial food content and the increased pH of the solution, which both contributed to the maintenance of physiological weight. Sucrose has been shown to function as an oxidisable respiratory substrate and anti-desiccant, increasing the fresh weight of the cut flower. Similar results were also obtained by Kashyap *et al*, (2022) [12] in tuberose.

Vase life

Among treatments, the maximum vase life (19.91) was found to be in treatment T_2 i.e., (2% sucrose + 400 ppm citric acid) in gladiolus flower. Pulsing with citric acid and sucrose enhanced solution uptake, fresh weight, flower freshness and reduced the respiration rate thereby enhancing the vase life of cut flowers. A similar result was obtained in chrysanthemum by De *et al*., (1996) [5] in gladiolus.

Among colours, the maximum vase life (19) was recorded in C_1 i.e., (Lemon yellow colour). This may be because there is a sufficient amount of food dye that is used for extending the vase's life. These results were in accordance with Varu and Barad (2010) [22] in tuberose cv. Double

In the interaction between treatment x colour the maximum vase life (25) was recorded in treatment T_2C i.e., (2% sucrose + 400 ppm citric acid in lemon yellow colour). The edible dyes used in the experiment alter the cell metabolism. Because of this, barriers were created that hinder the passage of food and water. As a result, the cell's osmotic pressure would change, changing the turgidity of the cell. The results could also be attributed to greater water absorption, which preserves better water balance and flower freshness, prevents early wilting, and lengthens vase life. These results are similar to the finding by Varu and Barad 2010 [22] in tuberose flowers.

The interaction between colour x duration, maximum vase life (20.1) was noticed in C_1D_1 i.e., (Lemon yellow colour for 2:30 hours). This may be due to more absorption of dye to the petals through the vasculatory system along with water or dye uptake Mekala *et al*. (2012) [17] in tuberose.

In gladilous flowers, the interaction between treatment x duration, and maximum vase life (21.16) days for the flower was observed in T_2D_1 (2% sucrose + 400 ppm citric acid for 2:30 hours). There was an increase in the vase life of flowers with adding preservative solution for 2:30 immersion time in colour. (Patil and Dhaduk 2008) [18] found Similar results in different floriculture crops.

The interaction between treatment x colour x duration of the maximum days (25.66) for the vase life of the flower was recorded in $T_2C_1D_1$ i.e., (Lemon yellow colour in 2% sucrose + 400 ppm citric acid for 2:30 hours). Food colour concentration did not have an effect on vase life, but pH variations have a significant impact on vase life. Kumar *et al*. (2003) [13] found similar findings. The levels of pH and sucrose were important in determining how long cut tuberose spikes would last in v.

Tables 1: Effect of chemical preservatives, tinting and duration along with their on vase life in Gladiolus (*Gladiolus* spp.)

	Bud opening	**Solution uptake**	**Weight loss**	**Vase life**
Treatments				
T_1	4.38	47.39	13.38	18.83
T_2	5.61	48.47	14.5	19.91
T_3	4.22	47.11	13.16	18.44
T_4	4.86	47.66	13.63	18.63
T_5	4.44	47.25	13.19	18.16
Food Colour				
C_1	4.9	47.85	13.8	19
C_2	4.95	47.86	13.9	18.83
C_3	4.26	47.02	13.03	18.56
Duration				
D_1	5.3	48.1	14.08	19.28
D_2	4.11	47.05	13.06	18.31
Interaction TxCxD				
$T_1C_1D_1$	4.83	47.83	13.83	18.83
$T_1C_2D_1$	5.5	48.5	14.5	19.5
$T_1C_3D_1$	4.5	47.5	13.5	18.5
$T_1C_1D_2$	4.33	47.33	13.33	19
$T_1C_2D_2$	4.16	47.16	13.16	18.5
$T_1C_3D_2$	3	46.03	12	18.66
$T_2C_1D_1$	11.66	54.66	20.66	25.66
$T_2C_2D_1$	4.83	47.83	13.83	18.83
$T_2C_3D_1$	4.5	46.83	12.83	19
$T_2C_1D_2$	3.16	46.16	12.16	18.16
$T_2C_2D_2$	4.83	47.83	13.83	18.83
$T_2C_3D_2$	4.66	47.54	13.66	19
$T_3C_1D_1$	5.16	48.16	14.16	19.16
$T_3C_2D_1$	4.5	47.5	13.5	18.5
$T_3C_3D_1$	4	47	13	19
$T_3C_1D_2$	3.16	46.33	12.16	17.16
$T_3C_2D_2$	5.16	47.66	14	19
$T_3C_3D_2$	3.33	46	12.16	17.83
$T_4C_1D_1$	3.83	46.16	12.16	18.16
$T_4C_2D_1$	5	48	14	19
$T_4C_3D_1$	6.16	48.83	14.83	19.83
$T_4C_1D_2$	3.83	46.16	12.16	17.16
$T_4C_2D_2$	5	48.5	14.5	19.16
$T_4C_3D_2$	6.16	48.33	14.16	18.5
$T_5C_1D_1$	5.66	48.5	14.33	18.66
$T_5C_2D_1$	4.83	47.66	13.66	18
$T_5C_3D_1$	4.5	46.5	12.5	18.66
$T_5C_1D_2$	4	47.16	13	18
$T_5C_2D_2$	5	48	14	19
$T_5C_3D_2$	2.66	45.66	11.66	16.66

Conclusion

From the present studies, it can be concluded that the maximum vase life was recorded in $T_2C_1D_1$ i.e., (2% sucrose + 400 ppm citric acid in lemon yellow colour for 2:30 hours) in gladiolus flower while the minimum was recorded in $T_5C_3D_2$ (Control (Distilled water) in pink colour for 3:30 hours). Among edible dye spikes tinted with yellow colour develop more uniform colour on florets of chrysanthemum and gladiolus. When the concentration of edible dye and immersion time increases of flower vase life of the flower spike decreases.

Acknowledgement: I am very obliged to my research advisor Dr. Jujhar Singh and my companions Harpreet Kaur and Alisha Kamboj for supporting me during my research.

Conflict of Interest: I have no personal motivation to have my paper published. For professional reasons, I wish to publicise it.

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