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Studies on the effect of acidifiers, biocides and food sources in combination on extension of vase life of gladiolus (*Gladiolus grandiflorus* L.) Cv. Swarnima

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Abstract
Different combination treatments were studied to enhance the vase life of cut gladiolus spikes. T_1: (Citric acid-200 ppm) + (Commercial bleach-50 ppm), T_2: (Citric acid-200 ppm) + (Sprite-100 ml), T_3: (Commercial bleach-50 ppm) + (Sprite-100 ml), T_4: (Citric acid-200 ppm) + (Commercial bleach-50 ppm) + (Sprite-100 ml), T_5: Control (Distilled Water). Among all the treatments .T_4-Citric acid 200 ppm＋ Commercial bleach 50 ppm ＋ Sprite 100 ml recorded highest water uptake (27.50, 18.29, 10.53 g), transpirational loss of water (25.40, 16.93, 9.20 g), water balance (7.10, 6.36, 5.59 g), fresh weight change percentage (106.12, 99.93, 89.16 %), low optical density of vase solution (0.019, 0.023, 0.030 nm) on 2nd, 4th, and 6th day of vase life respectively, minimum days for opening of first floret (1.73 days), maximum diameter of basal floret (10.48 cm), highest longevity of basal floret (2.94 days), maximum number of florets opened on spike when basal floret is fresh (2.65) and maximum number of florets opened per spike at the end of the vase life (11.18), highest vase life (9.97 days) and floret opening percentage (97.21 %) with a B: C ratio of 3.42.

Keywords: Cut gladiolus, vase life, citric acid, commercial bleach, sprite, postharvest quality

Introduction
Gladiolus, acclaimed as the *"Queen of bulbous flowers,"* is one of the most important ornamental bulbous crops worldwide due to its outstanding floral beauty. *Gladiolus* L. belongs to the family Iridaceae and the subfamily Ixoideae, with its origin in South Africa. The genus comprises approximately 180 species, and extensive breeding efforts have resulted in the development of nearly 10,000 cultivars. Owing to its wide range of floret colours and forms, gladiolus is widely cultivated for garden display and commercial floriculture. The crop has been known since ancient Greek times, and the name *Gladiolus*, coined by Pliny the Elder, is derived from the Latin word *gladius* (sword), referring to its sword-shaped leaves.

Longevity of cut flowers is a major challenge in modern floriculture, as vase life is one of the most important quality attributes influencing consumer preference, apart from external appearance. In gladiolus, the vase life of individual florets is relatively short, lasting only four to six days (Mayak, 1973) [6], and senesced florets persist at the basal portion of the spike even as upper florets continue to open (Serek, 1994) [10].

Gladiolus serves as an excellent model for studying floral senescence, as florets at different developmental and senescence stages occur simultaneously on the same spike (Azeez *et al.*, 2007) [1]. During senescence, a progressive decline in total protein content has been reported, predominantly associated with the activity of trypsin-type serine proteases.

Vase life extension of cut flowers largely depends on the composition of the vase solution, which typically includes three key components: a food source, a biocide or germicide, and an acidifying agent. The availability of an external energy source, commonly supplied through sugars, is crucial for prolonging vase life, as sugars act as respiratory substrates, replenish depleted carbohydrates, and prevent the degradation of structural organic compounds (Marousky, 1968) [5].

Acidifying agents enhance water uptake by lowering the pH of the vase solution, facilitating faster movement of water through the xylem and reducing microbial proliferation.

Compounds such as citric acid and ascorbic acid have been reported to extend vase life by improving water relations and limiting microbial growth in vase solutions (Vahdati, 2012) [13]. Microbial blockage of xylem vessels is a major cause of reduced cut flower quality, and the use of suitable biocides in vase solutions helps mitigate this problem.

Although commercial floral preservatives are effective, their limited availability, high cost, and potential health hazards restrict their widespread use. In contrast, locally available and natural preservative substances are safer, eco-friendly, inexpensive, and easily accessible for florists, retailers, and domestic use (Lambert, 2001) [4]. Common household and natural preservatives such as lemon juice, asafoetida, household bleach, vinegar, aspirin, coconut water, camphor, soft drinks, and plant-derived essential oils have been suggested for vase solutions. However, scientific information on their efficacy in extending the vase life of cut flowers, particularly gladiolus, remains limited.

Materials and Methods

The present investigation was conducted at the Post-harvest Laboratory, Floricultural Research Station, Agricultural Research Institute (ARI), Rajendranagar, Hyderabad, during the Rabi season of 2020-2021. The Floricultural Research Station, Rajendranagar, is located at an altitude of 542.3 m above mean sea level, at 78°29′ E longitude and 17°19′ N latitude, and experiences a semi-arid climate. The cut flowers were maintained under ambient laboratory conditions with an average temperature of 26 °C, relative humidity ranging from 42 to 89%, and illuminated with 40 W cool white fluorescent lamps to provide a 12-hour photoperiod.

Crop: Gladiolus (*Gladiolus grandiflorus* L.)

Cultivar: Swarnima

Design: Completely Randomized Design

Number of Treatments: 05

Number of Replications: 04

Number of Spikes/treatments: 02

Evaluation Interval: 02 days

TREATMENTS: T_1: (Citric acid-200 ppm) + (Commercial bleach-50 ppm), T_2: (Citric acid-200 ppm) + (Sprite-100 ml), T_3: (Commercial bleach-50 ppm) + (Sprite-100 ml), T_4:(Citric acid-200 ppm) + (Commercial bleach-50 ppm) + (Sprite-
100 ml), T_5: Control (Distilled Water)

Results and Discussion

Water uptake (g/spike)

Water uptake of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima during vase life as influenced by different combinations of acidifiers, biocides, and food sources is presented in Table 1. A progressive decline in water uptake was observed with the advancement of vase life. The maximum mean water uptake was recorded on the 2nd day (28.21 g), which gradually decreased to a minimum of 7.59 g by the 6th day. Effect of different treatments on water uptake during the vase life are recorded in Table 1.

Among the treatments, T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml) recorded significantly higher water uptake on the 2nd, 4th, and 6th days of vase life (27.50, 18.29, and 10.53 g, respectively). This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm), which recorded comparatively higher water uptake during the respective observation days.

On the 6th day, water uptake under T_3 (8.50 g) was statistically at par with T_1 (8.12 g), and T_1 was at par with T_2 (citric acid 200 ppm + Sprite 100 ml; 7.80 g). The control treatment (T_5) recorded the lowest water uptake throughout the vase life period, with values of 15.53, 5.38, and 3.01 g on the 2nd, 4th, and 6th days, respectively.

The highest water uptake observed in the treatment comprising citric acid (200 ppm) + commercial bleach (50 ppm) + Sprite (100 ml) (T_4) may be attributed to the effective control of microbial proliferation in the holding solution, resulting in reduced xylem occlusion and air embolism formation within the vascular tissues. The combined action of citric acid and commercial bleach likely minimized vascular blockage by inhibiting microbial growth and maintaining vessel patency, thereby ensuring uninterrupted translocation of water through the xylem. Furthermore, acidification of the vase solution, along with the addition of a wetting agent and carbohydrate source, is known to enhance water uptake in cut flowers (Durkin, 1981) [2]. These findings are in close agreement with those of Talukdar and Barooah (2011) [11], who reported maximum vase life in tuberose with a preservative solution containing 4% sucrose + 2% citric acid + 20 ppm $AgNO_3$, highlighting the synergistic role of energy source, acidifier, and biocide in improving post-harvest performance.

Transpirational loss of water (g/spike)

The results indicated a progressive decline in transpirational loss of water (TLW) from the beginning to the end of the vase life period of cut gladiolus. The highest mean TLW (21.27 g) was recorded on the 2nd day, whereas the lowest mean TLW (7.61 g) was observed on the 6th day of vase life. The vales noted are given in Table 2

Among the treatments, T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml) registered the maximum TLW on the 2nd, 4th, and 6th days (25.40, 16.93, and 9.20 g, respectively), followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml) (22.56, 12.77, and 8.33 g) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm) (22.38, 10.80, and 8.24 g). On the 2nd and 6th days, treatment T_3 was statistically at par with T_1 (22.56 vs. 22.38 g and 8.33 vs. 8.24 g, respectively). Further, on the 6th day, T_1 (8.24 g) was at par with T_2 (citric acid 200 ppm + Sprite 100 ml), which recorded a TLW of 8.09 g. In contrast, the control (T_5) consistently recorded the minimum TLW throughout the vase life period (15.03, 5.69, and 4.21 g on the 2nd, 4th, and 6th days, respectively).

The relatively higher transpirational water loss observed in T_4 may be attributed to its greater water uptake capacity, which facilitated enhanced transpiration compared to other treatments. The presence of sucrose in the holding solution likely maintained cell turgidity through increased water absorption, consequently leading to elevated transpirational loss. Similar observations regarding the influence of sucrose on water relations in cut flowers were reported by Murali (1990) [7].

Water balance

Observations on water balance varied significantly among the treatments. A gradual decline in water balance was recorded from the beginning to the end of the vase life of cut gladiolus. The highest mean water balance was observed on the 2nd day (6.47 g), which decreased to the lowest value on the 6th day (4.81 g). The noted values are given in Table 3.

Among the treatments, T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml) recorded the maximum water balance on the 2nd, 4th, and 6th days of vase life (7.10, 6.36, and 5.59 g, respectively). This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml) with values of 6.80, 6.13, and 5.17 g, and T_1 (citric acid 200 ppm + commercial bleach 50 ppm), which recorded 6.72, 6.06, and 4.88 g on the respective days.

On the 2nd day, T_3 (6.80 g) was statistically at par with T_1 (6.72 g), while on the 4th day, T_1, T_2, and T_3 were found to be at par. The control treatment (T_5) recorded the minimum water balance throughout the vase life, with values of 5.48, 4.68, and 3.74 g on the 2nd, 4th, and 6th days, respectively.

The higher water balance observed under T_4 may be attributed to the reduction in vase solution pH by citric acid and the antimicrobial action of commercial bleach, which together enhanced water uptake and regulated transpirational water loss during the initial days of vase life, resulting in improved hydration status of the floral tissues compared to other treatments.

Fresh weight change

Fresh weight change (FWC) of gladiolus spikes differed significantly among the treatments and exhibited a declining trend from the beginning to the end of the vase life. The highest mean fresh weight change (100.89%) was recorded on the 2nd day, which gradually decreased to the lowest value on the 6th day (80.79%).

Among the treatments, T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml) recorded the maximum FWC on the 2nd, 4th, and 6th days of vase life (106.12, 99.93, and 89.16%, respectively). This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml), which recorded 104.37, 96.29, and 87.59%, and T_1 (citric acid 200 ppm + commercial bleach 50 ppm) with corresponding values of 102.66, 94.16, and 80.13%. The control treatment (T_5) registered the minimum fresh weight change throughout the vase life period, with values of 93.19, 78.63, and 67.93% on the 2nd, 4th, and 6th days, respectively.

An increase in fresh weight is known to occur when water uptake exceeds transpirational water loss. The higher fresh weight change observed under T_4 may therefore be attributed to its ability to maintain greater water uptake relative to water loss during the initial days of vase life, resulting in improved hydration and enhanced fresh weight retention compared to other treatments.

Optical density of vase solution (480 nm)

The optical density of the vase solution during the vase life of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima, as influenced by different combinations of acidifiers, biocides, and food sources, is presented in Fig. 2. Significant differences in optical density were observed among the treatments on all observation days.

Among the treatments, T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml) consistently recorded the lowest optical density values on the 2nd, 4th, and 6th days of vase life (0.019, 0.023, and 0.030, respectively). This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm), which showed comparatively higher optical density values during the corresponding days. On the 2nd day of vase life, T_3 was statistically at par with T_1, while on the 6th day, T_1 was at par with T_2 (citric acid 200 ppm + Sprite 100 ml). The control treatment (T_5) recorded the highest optical density throughout the vase life period, with values of 0.078, 0.110, and 0.130 on the 2nd, 4th, and 6th days, respectively.

The reduced optical density observed under T_4 may be attributed to lower microbial load in the vase solution due to the antimicrobial action of commercial bleach and the maintenance of acidic pH by citric acid, resulting in greater clarity of the vase solution compared to other treatments.

Days to first floret opening (days)

The data pertaining to the effect of different combinations of acidifiers, biocides, and food sources on days to first floret opening during the vase life of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima are presented in Table 4. Significant variation in the time taken for first floret opening was observed among the treatments.

The minimum number of days to first floret opening was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), which registered 1.73 days. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml; 1.78 days) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm; 1.82 days), which were statistically at par with each other. The maximum number of days to first floret opening was observed in the control treatment (T_5), recording 2.75 days.

The earlier floret opening observed under T_4 may be attributed to improved water conductivity, higher fresh weight, and the availability of carbohydrates, which collectively enhanced physiological activity and promoted early opening of the basal floret.

Diameter of basal floret (cm)

The data on the diameter of the basal floret as influenced by different combinations of acidifiers, biocides, and food sources during the vase life of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima are presented in Table 4. The diameter of the basal floret showed significant variation among the treatments, ranging from 7.37 to 10.48 cm.

The maximum basal floret diameter was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), registering 10.48 cm. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml; 9.53 cm), which was statistically at par with T_1 (citric acid 200 ppm + commercial bleach 50 ppm; 9.43 cm) and T_2 (citric acid 200 ppm + Sprite 100 ml; 9.36 cm). The minimum basal floret diameter was observed in the control treatment (T_5), recording 7.37 cm.

The increased floret diameter under T_4 may be attributed to enhanced water uptake and retention in floral tissues, along with improved energy supply from sugars, which supported cell expansion and floret development.

Longevity of basal floret (days)

The data pertaining to the effect of different combinations of acidifiers, biocides, and food sources on the longevity of the basal floret during the vase life of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima are presented in Table 4. Significant differences in basal floret longevity were observed among the treatments.

The maximum longevity of the basal floret was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), which registered 2.94 days. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml; 2.76 days) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm; 2.63 days). The minimum basal floret longevity was observed in the control treatment (T_5), recording 1.08 days.

Preservative solutions are known to enhance vase life by supplying carbohydrates and inhibiting microbial proliferation (Halevy and Mayak, 1979) [3]. In the present study, the superior performance of T_4 may be attributed to its combined effect of carbohydrate supplementation and antimicrobial action, which collectively contributed to the prolonged longevity of the basal floret.

Number of florets opened on spike when basal floret is fresh

The number of florets opened on spike when basal floret is fresh is depicted in Table 5. Significant variation was observed among the treatments with respect to the number of florets opened on the spike when the basal floret remained fresh. The maximum number of florets opened was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), registering 2.65 florets per spike. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml), which recorded 2.20 florets and was statistically at par with T_1 (citric acid 200 ppm + commercial bleach 50 ppm), which recorded 2.15 florets. The minimum number of opened florets was observed in the control treatment (T_5), with a mean value of 0.62 florets per spike.

Acidification of vase solution and the addition of wetting agents and floral preservatives are known to enhance water uptake in cut flowers (Durkin, 1981) [2]. The higher number of florets opened under T_4 may therefore be attributed to improved water uptake and uninterrupted xylem conductivity, which facilitated effective translocation of available sugars to the upper florets, promoting floret opening before senescence of the basal floret.

Number of florets opened per spike at the end of vase life

The number of florets opened per spike at the end of vase life varied significantly among the treatments Table 5. The maximum number of florets opened was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), with a mean of 11.18 florets per spike. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml), which recorded 10.30 florets, and T_1 (citric acid 200 ppm + commercial bleach 50 ppm), which recorded 9.78 florets and was statistically at par with T_2 (citric acid 200 ppm + Sprite 100 ml), recording 9.61 florets per spike. The control treatment (T_5) recorded the minimum number of opened florets (6.40 per spike).

The superior performance of T_4 in terms of floret opening may be attributed to improved water relations and enhanced availability of reserve carbohydrates, which are known to play a crucial role in floret opening in spike-type flowers (Patra and Mohanty, 2015) [8].

Vase life of spike (days)

The data pertaining to the effect of different combinations of acidifiers, biocides, and food sources on the vase life of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima are illustrated in Fig 3. Vase life of spikes varied significantly among the treatments, ranging from 6.10 to 9.97 days.

The maximum vase life was recorded in T_4 (citric acid 200 ppm + commercial bleach 50 ppm + Sprite 100 ml), registering 9.97 days. This was followed by T_3 (commercial bleach 50 ppm + Sprite 100 ml; 9.66 days) and T_1 (citric acid 200 ppm + commercial bleach 50 ppm; 9.38 days), which was statistically at par with T_2 (citric acid 200 ppm + Sprite 100 ml; 9.34 days). The minimum vase life was observed in the control treatment (T_5), recording 6.10 days.

The superior vase life recorded under T_4 may be attributed to improved water relations and effective control of microbial growth. This treatment provided the three essential components of an ideal vase solution, namely an acidifier, a carbohydrate source, and a germicide, thereby delaying senescence more effectively than other treatments. Similar findings were reported by Thwala *et al.* (2013) [12] in orchids using a combination of Sprite, lemon juice, and bleach.

Floret opening percentage (%)

The data regarding the Combinational effect of acidifiers, biocides, food sources on floret opening percentage of during the vase life period of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima is illustrated in Fig 4.

Among all the treatments maximum percent of florets opened (97.21 %) was recorded with T_4-Citric acid 200 ppm＋Commercial bleach 50 ppm＋Sprite 100 ml followed by T 3-Commercial bleach 50 ppm＋Sprite 100 ml (89.56 %), T_1-Citric acid 200 ppm＋Commercial bleach 50 ppm (85.04 %). Lowest percentage was observed with T_5-Control (55.6 %).

Water uptake without interruption helps in more number of floret to open, as Citric acid 200 ppm + Commercial bleach 50 ppm + Sprite 100 ml (T_4) recorded high water uptake this might have resulted in high floret opening

Table 1: Water uptake by gladiolus spikes during the vase life period

Treatments (T)	Water uptake (g)			
	Day 2	Day 4	Day 6	Day 8
T_1-Citric acid 200 ppm＋Commercial bleach 50 ppm	24.10	11.86	8.12	6.69
T_2-Citric acid 200 ppm ＋Sprite 100 ml	22.23	10.73	7.80	6.24
T_3-Commercial bleach 50 ppm＋Sprite 100 ml	24.36	13.90	8.50	7.17
T_4-Citric acid 200 ppm＋Commercial bleach 50 ppm＋ Sprite 100 ml	27.50	18.29	10.53	7.90
T_5-Control (DW)	15.53	5.38	3.01	-
Mean	28.21	12.03	7.59	
SE (m) ±	0.05	0.07	0.11	
CD at 5 %	0.15	0.23	0.38	

Table 2: Transpirational Loss of Water during the vase life period of cut gladiolus spikes.

Treatments (T)	Transpirational loss of water(g)			
	Day 2	Day 4	Day 6	Day 8
T_1-Citric acid 200 ppm＋Commercial bleach 50 ppm	22.38	10.80	8.24	7.20
T_2-Citric acid 200 ppm＋Sprite 100 ml	20.98	9.73	8.09	7.11
T_3-Commercial bleach 50 ppm＋Sprite 100 ml	22.56	12.77	8.33	7.32
T_4-Citric acid 200ppm＋Commercial bleach 50 ppm＋Sprite 100 ml	25.40	16.93	9.20	7.50
T_5-Control (DW)	15.03	5.69	4.21	_
Mean	21.27	11.18	7.61	
S.E (m) ±	0.06	0.14	0.06	
CD at 5 %	0.20	0.46	0.19	

Table 3: Effect of combinational treatments on water balance of cut gladiolus spikes.

Treatments (T)	Water balance (g)			
	Day 2	Day 4	Day 6	Day 8
T_1-Citric acid 200 ppm ＋	6.72	6.06	4.88	4.49
Commercial bleach 50	(1.72)	(1.06)	(-0.12)	(-0.51)
Ppm				
T_2 -Citric acid 200 ppm ＋ Sprite 100 ml	6.27 (1.27)	6.00 (1.00)	4.71 (-0.29)	4.13 (-0.87)
T_3- Commercial bleach 50 ppm＋Sprite 100 ml	6.80 (1.80)	6.13 (1.13)	5.17 (0.17)	4.85 (-0.15)
T_4- Citric acid 200ppm ＋ Commercial bleach 50 ppm＋Sprite 100 ml	7.10 (2.10)	6.36 (1.36)	5.59 (0.59)	5.40 (0.40)
T_5-Control (DW)	5.48	4.68	3.74	
	(0.48)	(-0.32)	(-1.26)	_
	6.47	5.84	4.81	
Mean	(1.47)	(0.84)	(0.19)	
S.E (m) ±	(0.07)	(0.06)	(0.07)	
CD at 5 %	(0.25)	(0.19)	(0.02)	

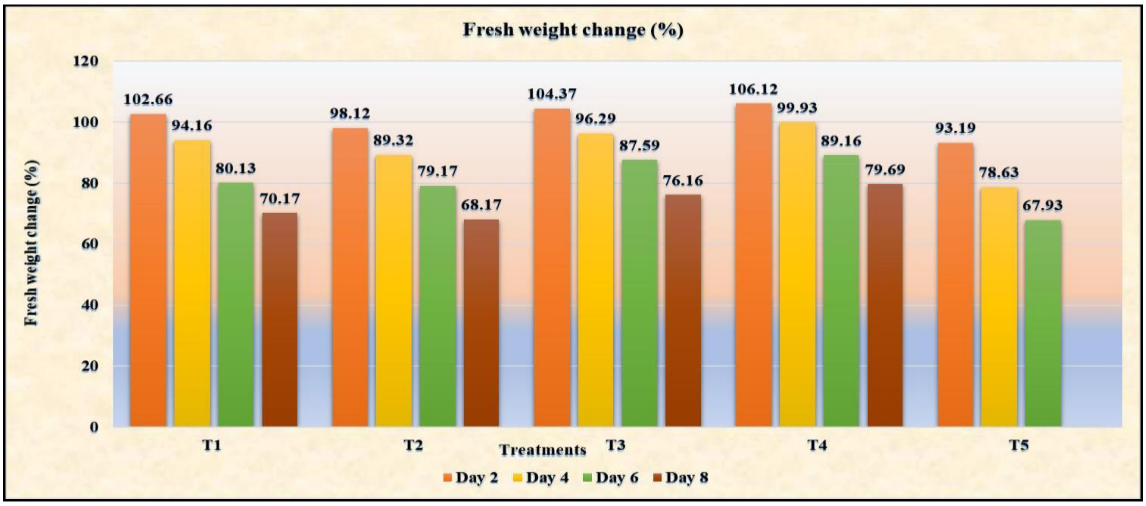

Fig 1: Showing Fresh weight change of cut gladiolus spikes

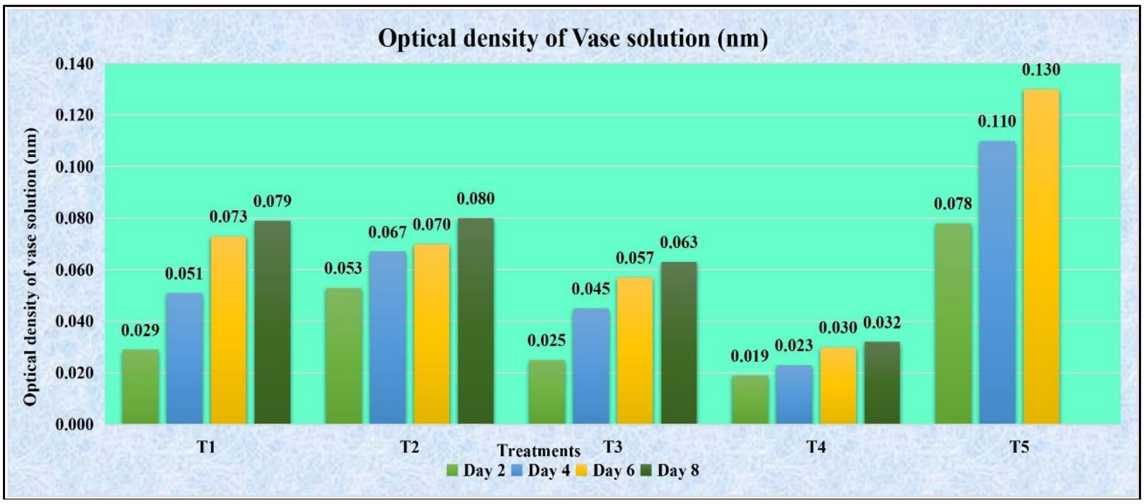

Fig 2: Representing the optical density of vase solution during the vase life period of cut gladiolus spikes

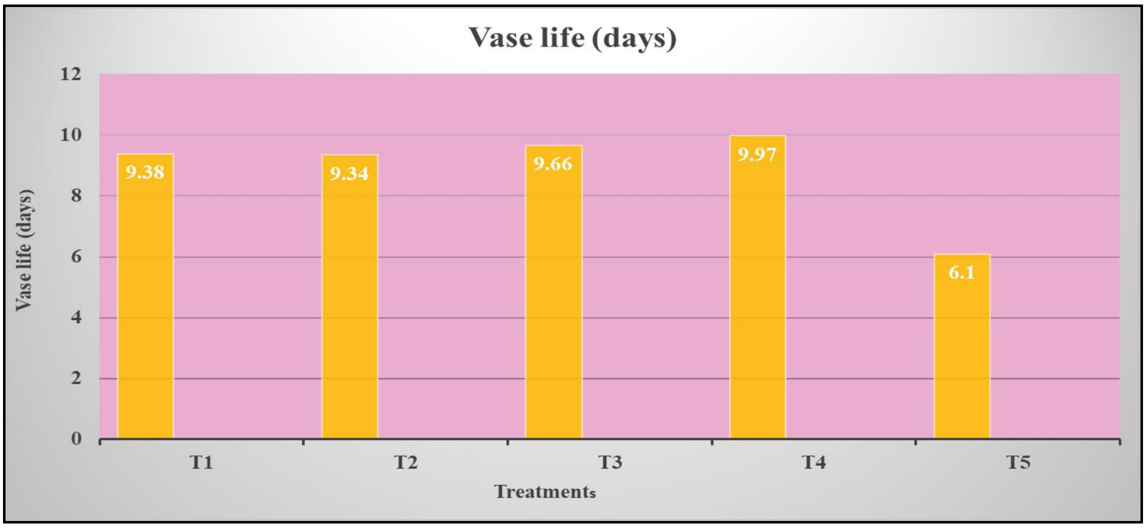

Fig 3: Representing the Vase life of cut gladiolus spikes on treatment with different treatments

Table 4: Combinational effect of commonly available preservatives on days to first floret opening (days), diameter of basal floret (cm) and longevity of basal floret (days) during vase life period of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima**.**

Treatments (T)	Days to first floret opening (days)	Diameter of basal floret (cm)	Longevity of basal floret (days)
T_1-Citric acid 200 ppm + Commercial bleach 50 ppm	1.82	9.43	2.63
T_2-Citric acid 200 ppm + Sprite 100 ml	1.90	9.36	2.47
T_3-Commercial bleach 50 ppm+ Sprite 100 ml	1.78	9.53	2.76
T_4-Citric acid 200 ppm+Commercial bleach 50 ppm Sprite 100 ml	1.73	10.48	2.94
T_5-Control (DW)	2.75	7.37	1.08
Mean	1.99	9.27	2.37
S.E (m) ±	0.01	0.11	0.04
CD at 5 %	0.04	0.35	0.12

Table 5: Combinational effect of commonly available preservatives on number of florets opened when basal floret is fresh and number of florets opened per spike at the end of vase period of gladiolus (*Gladiolus grandiflorus* L.) cv. Swarnima

Treatments (T)	Number of florets open when basal floret is fresh	Number of florets opened per spike at the end of vase life
T_1-Citric acid 200 ppm+Commercial bleach 50 ppm	2.15	9.78
T_2-Citric acid 200 ppm +Sprite 100 ml	2.00	9.61
T_3-Commercial bleach 50 ppm+Sprite 100 ml	2.20	10.30
T_4-Citric acid 200 ppm + Commercial bleach 50 ppm + Sprite 100 ml	2.65	11.18
T_5-Control (DW)	0.62	6.40
Mean	1.92	9.45
S.E (m) ±	0.04	0.08
CD at 5%	0.12	0.23

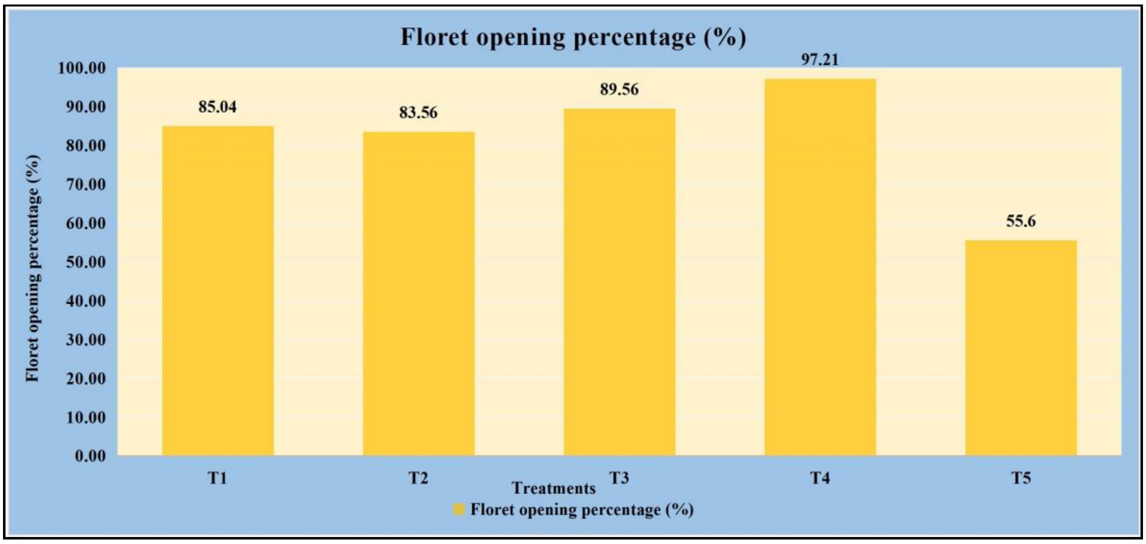

Fig 4: Represents Floret opening percentage of cut gladiolus spikes

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