

# Review on Effect of Different Preservatives on Vase Life of Gladiolus

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**Abstract:** Globally gladiolus is one of the most demanding flowers and day by day its usage has been increased. This study will give us an insight on the different methods and ways to increase the vase life of gladiolus, mainly focuses on the impact of floral preservatives. Different preservative solutions were applied to the cut stems of gladiolus blooms and their effect on flower freshness, color retention, water uptake and overall longevity were evaluated. Different preservatives used to enhance the vase life are sucrose solution, Cobalt Sulphate ( $\text{CoSO}_4$ ), Calcium, Salicylic acid, different concentration of  $\text{GA}_3$ , CCC, NAA.  $\text{GA}_3$  proves the best PGR for pre harvest treatment to maintain quality of flowers. Sucrose solution of 4% along with  $\text{CoSO}_4$  is a good combination to extend the vase life of flower. Results indicate that certain preservatives significantly extend the vase life of gladiolus flowers by providing essential nutrients, regulating water balance and inhibiting microbial growth. These findings offer valuable insights for optimizing post-harvest management practices to enhance the quality and longevity of gladiolus blooms in floral arrangements.

**Keywords;** Gladiolus, Vase life, PGR, Preservatives, Flower quality, Microbial growth, Postharvest management.

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### **Introduction**

Gladiolus (*Gladiolus grandiflorus L.*) is one of the most important ornamental and bulbous flowering plants, it carries noble history with it. The name of Gladiolus derived from Latin word "Gladius (Sword)", hence it known as Sword lily. It originates from South Africa and Asia belong to monocot family Iridaceae (Prabhesh et al., 2022). Gladiolus also known as "Queen of bulbous plant" and is well known in every corner of the globe which ranks 8<sup>th</sup> position in cut flowers, 1<sup>st</sup> position in bulbous plants

and has more than 150 species in the world trade whose leading country is .....?..... (Lamichhane *et al.*, 2022). The number of species found in the genus is 255 (Shaukat *et al.*, 2013). The main goal is to grow beautiful cut flowers that can be sold in local flower markets or used for decoration in gardens. However, it's worth mentioning that the dried bulbs of these flowers have medicinal benefits when ground into powder. Gladiolus is a perennial bulbous and half-hardy flowering plant containing attractive, elegant and delicate florets opening in sequence from bottom to top along with the spikes. They vary in their height from one to four feet; some are soft and light, others robust and strong adapted to any climate except the frigid condition (Childs, 1873). Vase life of *gladiolus* flower is noticeably short due to blockage of the vascular system by air or bacterial growth, reducing water uptake and blocking xylem vessels called as **Vascular occlusion**. Short vase life of cut flower has been a major problem in floriculture industry as the longevity of vase life is a crucial factor in consumer preference (Marand *et al.*, 2011).

Different **studies and experiments** have proved that vase life of gladiolus can be extended by adding or subjecting to different chemical solutions at **various** concentration such as; chlorine hydroxyquinoline, sulphates, salicylic acid, humic acid, silver nanoparticles, sugar solutions, diethyl sulphonate, and different plant growth regulators (Lamichhane *et al.*, 2022). The American Conference of Governmental Industrial Hygienists has recommended exposure limit of soluble silver compounds by  $0.01 \text{ mg/m}^3$ . While ionic silver compound has a toxic effect on human as well as environment, organic acid and essential soil **also** **have** a noticeable effect on the improvement of vase life of cut gladiolus flowers which might be due to their antibacterial properties that reduce bacterial proliferation in the stem vessels of cut flowers (Jowkar *et al.*, 2012; Marand *et al.*, 2011). Therefore, this study aims to evaluate various vase solutions and **their effectiveness in extension of vase life, quality of the produce and in turn about the cost of vase solutions.**

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## **VaselifeofGladiolus**

Vase life of a flower is influenced by respiration, carbohydrates, deterioration, disease and pests and water absorption. Ethylene synthesis plays a crucial role in vase life. Various factors including water stress, carbohydrate depletion, microbial activity and ethylene exposure can impact floral senescence. To prolong the vase life of cutflowers by mitigating the above effects, preservative solutions are employed post-harvest. These solutions enhance assimilate distribution, regulate water uptake, shield floral tissues from microbial damage and minimize the influence of ethylene, thereby delaying the onset of floral senescence (Pulido *et al.*, 2021). Carbohydrates and soluble sugar help to maintain quality of petals for longer time. Flowers are treated with sufficient amounts of sugars like sucrose and an appropriate preservative like silver thiosulfate can greatly enhance the longevity of cut flowers (Hussan *et al.*, 2016). As discussed earlier, not only sucrose but along with sucrose there are other agents also that are effective in extending the vase life of cutflowers.

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## **Pre and Postharvest affecting factors.**

### **A. Preharvest affecting factors:**

#### **i. Constitution of Inherent characters:**

The genetic composition of the cultivars as well as differences in cell wall thickening, peroxidase and lignification levels, ethylene forming enzyme (EFE) and aminocyclopropane carboxylic acid (ACC) production have all been linked to these variations (Khanal, 2014). Khanal (2014) assessed six gladiolus cultivars in Hissar, India and discovered variance in the responses of the varieties for various attributes. Miniature had the shortest vase life among the tested cultivars while Pusa Suhagain had the longest. Similarly, five gladiolus cultivars i.e. Agnerekha, American Beauty, Friendship, Mansoer red and true Yellow were assessed in a course of two seasons in Kerala, India by Khanal (2014) and mentioned that Agnerekha and Mansoer were the best for a longer vase life, while American Beauty and Friendship were found to be superior for cut flower yield. Variations in stem lignification, flower diameter, fresh weight, water uptake, and other factors are caused by genetic diversity and ultimately result in differences in the vase life of various flowers or different types of the same flowers. Even genetic variations exist among many cultivars of the same crop, as following different varieties with different days of vase life, IIHR-G-12 (14.20), Urmil (8.97), American Beauty (9.67), Moon Magic (5.39) (Verma and Singh, 2021). Differences in the genetic structure of flower species and varieties result in significant differences in their post-harvest lifespan (Gupta and Dubey 2017). An experiment was conducted on the different varieties of gladiolus, it showed the best performance for maximum number of corms per plot was "Legend" (37.67) and "Trader Horn" was maximum number of corms per plant (70.83). The maximum vase life was observed in "Darsan" (17.56 days) and maximum number of florets remaining open at a time in vase was observed in "Hunting Song" (6.78 florets) (Singh *et al.*, 2017).

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## **ii. Environmental Factors:**

### **a. Temperature**

By an increase in respiration rate, high temperatures can reduce floral quality and carbohydrate supplies. According to some observations, the longevity of cut flowers was reduced by temperatures as low as 12°–15°C or as high as 27°C during the three weeks before to harvest. The knowledge of temperature impact on vase life is complicated by the potential interplay of temperature with other factors. The reduced amount of carbohydrates in petals as a result of the cold temperature and weak light will cause the vase life to be shortened. Sugar level has been found to be closely associated with the postharvest life of cut flowers because temperature and light intensity directly affect the photosynthate level in flower tissues (Khanal, 2014).

### **b. Relative Humidity:**

High relative humidity (RH) levels (over 80% to 90%) shorten the postharvest life of cut flowers because they negatively impact the amount of calcium content (Mortensen and Fjeld, 1998). High relative humidity of 90–95% is advised and is crucial for long-term storage because calcium level in the tissue is thought to affect the formation and function of the cell wall and membrane (Hardenburget *al.*, 1986). RH of 80% or above is generally utilised in practice for short-term storage (1-2 days) because it is safe enough to delay withering due to moisture loss. Verma and Singh (year.....) mentioned Humidity useful in preventing water loss from the plant's surface and preserving the temperature of the plant. While high humidity promotes photosynthesis, it can also lead to fungus-related illnesses. Reduced humidity can lead to greater water loss, senescence, thin leaves, browning of the leaf margins and chilling injury. Water stress can therefore clearly shorten a flower's vase life (Bhattacharjee and De, 2005) and flowers produced at varying humidity levels will exhibit variations in their vase life (Verma and Singh, 2021).

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## **B. Postharvest affecting factors**

### **i. Ethylene:**

Senescence is the time when flower petals produce ethylene. The two primary enzymes in charge of producing ethylene are ACC oxidase and ACC synthase (Verma and Singh, 2021). Certain essential growth stages, such as the wilt of flowers and the abscission of leaves, together with other external conditions like mechanical injury and environmental stress, drive the production of ethylene (Vehniwal and Abbey, 2019). Carbon makes up the majority of plant dry matter (45%). Through the stomata, plants absorb it from the surrounding air and fix it through the process of photosynthesis (Verma and Singh, 2021).

### **ii. Carbon dioxide:**

When cultivated at low and high CO<sub>2</sub> levels during the vegetative phase respectively, plants grown at elevated CO<sub>2</sub> during the generative growth phase produce 10-15 % more plants with multiple spikes and a better floral stem quality. The quantity of spikes was not significantly affected by elevated CO<sub>2</sub> throughout the vegetative growth phase, but the pattern suggests that spike quality was on the rise (Kromwijk *et al.*, 2014)

### **iii. Pest and diseases**

Fusarium wilt, Yellow or corm rot, Storage rots, Dry or neck rot, Botrytis blight and flower rot, virus disease are some of the common diseases of gladiolus which can be directly or indirectly in low or high percentage affected the vase life of gladiolus. This can be managed by following various management practices.

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## **Importance of Sucrose**

Adding sugars in a vase solution has been found to be beneficial for prolonging the freshness and lifespan of cut flowers, it is associated with the improvement of water balance, improvement of color in case of carnation and rose, **it helps** to stimulate flower opening (Ichimura, 1998). Sucrose, administered via pulse therapy, suppressed the genes involved in ethylene biosynthesis, leading to a decrease in ethylene production. However, in contrast to the control group, sucrose treatment notably increased xylem blockage on the cut stem surfaces while decreasing antioxidant activity, relative fresh weight and the expression of the cysteine proteinase inhibitor gene (DcCPI) (Park *et al.*, 2017). Sugar plays a crucial role in extending the life span of flowers, particularly when they are cut, as they no longer receive essential nutrients and hormones from the parent plant (Muraleedharan and Joshi 2017).

## **Effect of Sucrose**

Han 1992, conducted research on the effect of sucrose solution has showed that the presence of sucrose in the vase solution improves the quality of cut spikes by prolonging their display life and enhancing the length of inflorescence with visible color. When a consistent supply of sucrose is provided in the vase solution, it leads to the complete opening of flower heads, achieving a 100% opening rate, 200 ppm of citric **acid** with 4% of sucrose is good to **extend** the vase life of gladiolus (Koirala *et al.*, 2022). Sucrose 4% combined with  $\text{CoSO}_4$  @ 100 ppm proved long duration of vase life with 12.3 days and **maximum** blooming period **of** 22.3 days (Singh and Beura 2002). In case of *Vriesea incurvata* Gaudich, (Bromeliaceae), **the** application of sucrose for 8 hours has been shown to enhance the preservation of color, brightness, and turgidity in floral scapes. It aids in maintaining water balance, reducing the loss of fresh weight, and extending the vase life of flowers by up to 24 days (Pulido *et al.*, 2021). Sucrose preserved a noticeably better water balance in spikes when combined with cobalt chloride and silver nitrate, which extended the vase life. Cobalt chloride is very effective at preventing vascular blockages that result from bacteria blocking vascular tissues. It has also been shown that treating iris spikes with  $\text{CoCl}_2$  greatly extends their vase life (Singh and Sharma, 2003).

## Importance of Chemicals

Chemical treatments considerably enlarged the spikes, floret diameter and increased holding solution consumption and solution absorption to its maximum compared to the control. (Singh and Sharma, 2003). The calcium effectiveness in enzymes activation, enhances antioxidant activities and delays senescence in gladiolus and also helps to increase diameter of xylem with good water flow, it can delay senescence (Ahmad and Rab, 2020). Salicylic acid (SA) considered as the messenger of molecules it involves in disease in plants which response to pathogenic attack, it plays key role to tackle the environmental stress and plant growth development (Mohammadi *et al.*, 2013).

## Effect of chemicals

Gladiolus spikes were treated with vase holding solution of calcium of 0, 100, 200, 300 and 400 mM and the results found that 200 mM calcium delayed flower opening and fading, superior in quality retaining (Ahmed and Rab, 2020). Calcium sulphate also increases the vase life of flower spike (Kumar *et al.*, 2007). According to the Marandi (2011), Salicylic acid (Acidifying agent) also known as SA, is a basic compound found in plants that helps regulate various aspects of their growth and development. It plays a role in processes like the opening and closing of tiny pores called stomata, the sprouting of seeds, the absorption of essential minerals, the determination of plant gender and the activation of defense mechanisms against diseases. The findings of this study indicate that among all the treatments, Acidifying agent salicylic acid (SA) had the most positive impact on the fresh weight percentage, solution uptake in terms of volume ( $\text{cm}^3$ ) and overall vase life of the cut flowers. Some studies have found that the application of salicylic acid can extend the vase life of flowers by reducing their respiration rate and inhibiting ethylene production.

Additionally, research has demonstrated that salicylic acid enhances the ability of flowers to withstand water deficit stress, resulting in improved vase life for cut rose flowers (Mehdikhah *et al.*, 2016). The use of sucrose in conjunction with antimicrobial agents (Germicide *i.e.* HQS and  $\text{AgNO}_3$ ) and an ethylene inhibitor ( $\text{AgNO}_3$ ) enhanced the carbohydrate content in flowers, improved water uptake, delayed senescence, preserved flower turgidity, decreased bacterial growth, and minimized xylem blockage. These combined effects resulted in superior flower quality and prolonged longevity (Mishra and Khanal, 2019).

### Effect of Growth Regulators on Physiological Parameters

Sable *et al.*, (2015) studied the effect of foliar application of plant growth regulators on gladiolus *cv.* H.B. Pitt, corms treated with Bavistin 0.1% and plants sprayed with  $\text{GA}_3$ , NAA, CCC in different range. It founds  $\text{GA}_3$  at 200 ppm was effective for elongation of cell and internodal length, height of plant and maximum number of leaves, increase the number of florets and its weight, overall it enhances the growth and quality of flower. Padmalatha *et al.*, (2015) was conducted a study on two *cv.*s. Darshan and Dhirajit found the influence of foliar application of BR...?.....full form (10 ppm) along with  $\text{GA}_3$  (150 ppm) significant effect in increasing number of corms and cormels at the stage of 3<sup>rd</sup> and 6<sup>th</sup> leaf stage, increase weight and size of corms, it can be suggested for multiplication of high-quality planting material and extending vase life of gladiolus. The use of Gibberellic acid on gladiolus corms has proved to be a successful method for overcoming dormancy and enhancing various aspects of plant development. This treatment has been found to have a positive impact on vegetative growth, improve the quality of flowers, and contribute to the enlargement of both corms and cormels in gladiolus plants (Priyanka,.....(year) and Holkar *et al.*, 2018).

### Conclusion:

Gladiolus is one of the most demanding cut flowers throughout the world, however flowers are perishable and day by day gladiolus industry is growing, due to this more research into new technologies is highly necessary to address the severe decline in vase life of gladiolus flowers. It has been shown that the aforementioned strategies can prolong the flower's post-harvest life.

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