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Evaluating Floral Preservatives for Extending the Vase Life of Gladiolus

Aniketkumar L. Bijewar[1], Dhruvkumar C. Savaliya[2], Rashi Jain[3], Karishma Borah[4] and Sarat Sekhar Bora[5]

Abstract: -

Gladiolus is a widely cultivated ornamental plant and popular cut flower globally, known for its attractive spikes. However, its vase life is relatively limited due to factors like water stress, carbohydrate depletion, microbial growth, and exposure to ethylene. This review explores various preharvest and postharvest factors affecting the vase life of gladiolus flowers. During the preharvest phase, genetic traits, environmental conditions such as temperature and humidity, and biotic stresses can influence vase longevity. In the postharvest stage, elements like ethylene production, carbon dioxide levels, and pest or disease issues significantly affect flower quality. The application of chemical preservatives, including sucrose, salicylic acid, and growth regulators like gibberellic acid, has proven effective in prolonging vase life and maintaining the quality of cut gladiolus. An integrated approach to managing these factors can enhance the postharvest durability and market appeal of gladiolus as a cut flower.

Introduction:

Gladiolus (Gladiolus grandifloras L.) is a significant ornamental and bulbous flowering plant, often referred to as the "Sword lily" due to its Latin name Gladius, meaning "sword." Originating from South Africa and Asia, this monocot belongs to the Iridaceae family. Known as the "Queen of bulbous plants," gladiolus ranks highly in the global floriculture industry, holding the 8th position among cut flowers and the top spot

Aniketkumar L. Bijewar[1], Dhruvkumar C. Savaliya[2], Rashi Jain[3], Karishma Borah[4] and Sarat Sekhar Bora[5]

[1]Ph.D. Research Scholar, Department of Floriculture and Landscape Architecture, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

[2]M.Sc. (Horticulture), Department of Floriculture and Landscape Architecture, ASPEE College of Horticulture, Navsari Agricultural University, Navsari, Gujarat

[3]Master's Scholar, Department of Floriculture and Landscaping Architecture, Faculty of Agriculture Sciences, Aligarh Muslim University, Aligarh, Uttar Pradesh

[4]Assistant Professor, Department of Horticulture, Assam down town University, Guwahati, Assam

[5]Young professional I, Department of Agronomy, AAU, Jorhat, Assam

among bulbous plants, with over 150 recognized species. The genus itself includes around 255 species. The primary objective of cultivating gladiolus is to produce aesthetically pleasing cut flowers for local markets and garden decorations. Notably, the dried bulbs have medicinal properties when powdered. As a perennial bulbous plant, gladiolus features elegant and delicate florets that bloom sequentially from the bottom to the top of its spike. The plant can range in height from one to four feet, with varieties adapted to most climates except extremely cold conditions. However, the vase life of cut gladiolus flowers is often limited, primarily due to vascular occlusion caused by air bubbles or bacterial growth, which obstructs water uptake and clogs the xylem vessels. This reduced vase longevity is a major issue in the floriculture industry since consumer preference is highly influenced by the vase life of cut flowers. Research indicates that the vase life of gladiolus can be extended using various chemical treatments. Solutions such as chlorine, hydroxyquinoline sulphates, salicylic acid, humic acid, silver nanoparticles, sugar solutions, diethyl sulphonate, and different plant growth regulators have shown promising results. However, while silver nanoparticles are effective in prolonging vase life, their ionic forms pose toxicity risks to humans and the environment. Organic acids and essential oils have also demonstrated efficacy in extending vase life due to their antibacterial properties, which inhibit bacterial growth in the stem vessels.

This study aims to evaluate different vase solutions and their effectiveness in enhancing the vase life and quality of cut gladiolus flowers, as well as to assess the cost-effectiveness of these treatments.

Vase Life of Gladiolus

The vase life of cut flowers is influenced by several factors such as respiration rate, carbohydrate levels, deterioration, susceptibility to diseases and pests, and water absorption efficiency. A key player in determining vase life is ethylene synthesis, which accelerates floral senescence. Various conditions including water stress, depletion of carbohydrates, microbial activity, and ethylene exposure contribute to the premature aging of flowers. To counteract these effects and extend vase life, post-harvest treatments using preservative solutions are commonly applied. These solutions help improve the distribution of nutrients, regulate water uptake, protect flower stems from microbial damage, and reduce the impact of ethylene, thereby delaying the aging process of the flowersydrates, especially soluble sugars, play a critical role in maintaining the freshness and quality of petals over time. Treating flowers with sugars like sucrose, often combined with preservatives such as silver thiosulfate, has proven effective in extending the longevity of cut flowers. Apart from sucrose, other agents have also been identified for their effectiveness in prolonging vase life.

Gladiolus (Gladiolus grandifloras L.), cultivated primarily for its showy inflorescences, is a highly valued ornamental plant in the floriculture industry. Enhancing the quality and vase life of gladiolus flowers is essential for growers and vendors, as the duration of vase life significantly affects the overall quality, customer satisfaction, and commercial value of the flowers. Differences in vase life across various species and cultivars are key factors influencing their market appeal. This review offers valuable insights into pre- and post-harvest factors as well as vase solutions that can help improve the vase life of gladiolus, serving as a useful resource for the scientific community.

Pre harvest affecting factors

Constitution of Inheritant characters

The genetic makeup of gladiolus cultivars, along with differences in cell wall thickening, peroxidase activity, lignification levels, ethylene-forming enzyme (EFE) production, and aminocyclopropane carboxylic acid (ACC) levels, are factors linked to variations in vase life among different varietiesudy conducted by Khanal in Hissasix gladiolus cultivars were evaluated for various traits. The cultivar 'Miniature' exhibited the shortest vase life, while 'Pusa Suhagain' showed the longest. Another assessment of five cultivars—Agnerekha, American Beauty, Friendship, Mansoer Red, and True Yellow—in Kerala, India revealed that 'Agnerekha' and 'Mansoer' had the longest vase life, while 'American Beauty' and 'Friendship' had the highest cut flower yield. Genetic diversity influences traits such as stem lignification, flower diameter, fresh weight, and water uptake, leading to differences in the vase life of various flowers or even different types of the same species. Variations also exist within cultivars of the same crop, as demonstrated by differing vase life durations among gladiolus varieties like IIHR-G-12 (14.20 days), Urmil (8.97 days), American Beauty (9.67 days), and Moon Magic (5.39 days), as reported by Verma and Singh (2021).

In another experiment focusing on different gladiolus varieties, 'Legend' showed the best performance in terms of the highest number of corms per plot (37.67), while 'Trader Horn' produced the most cormels per plant (70.83). The longest vase life was recorded for the cultivar 'Darshan' (17.56 days), and the highest number of florets open at one time in a vase was observed for 'Hunting Song' (6.78 florets) .

Postharvest affecting factors

Ethylene: Senescence is the stage when flower petals start producing ethylene, a key hormone responsible for the aging process. The production of ethylene is primarily regulated by two enzymes: ACC synthase and ACC oxidase synthesis is triggered during crucial growth stages, such as flower wilting and leaf abscission, as well as in response to external factors like mechanical damage and environmental stress. Carbon, titutes about 45% of the plant's dry matter, is absorbed from the atmosphere through the stomata and is then fixed in the plant via photosynthesis.

Carbon dioxide: When cultivated at low and high CO2 levels during the vegetative phase respectively, plants grown at elevated CO2 during the generative growth phase produces 10-15 % more plants with multiple spikes and a better floral stem quality. The quantity of spikes was not significantly affected by elevated CO2 throughout the vegetative growth phase, but the pattern suggests that spike quality was on the rise.

Importance of Sucrose

Adding sugars like sucrose to vase solutions has proven effective in extending the freshness and lifespan of cut flowers. This is mainly due to improvements in water balance and enhanced color quality, especially in flowers like carnations and roses, as well as stimulation of flower opening. When sucrose is administered via pulse therapy, it has been shown to suppress genes involved in ethylene biosynthesis, which reduces ethylene production—a key factor in flower senescence. However, unlike untreated flowers, sucrose-treated flowers exhibited increased xylem blockage on cut stem surfaces. This treatment also led to decreased antioxidant activity, lower relative fresh weight, and reduced expression of the cysteine proteinase inhibitor gene (DcCPi). Sugars are vital for prolonging the lifespan of cut flowers since, once severed, they no longer receive essential nutrients and hormones from their parent plants.

Effect of Sucrose

Research conducted by Han in 1992 demonstrated that adding sucrose to vase solutions significantly enhances the quality and display life of cut flower spikes. The presence of sucrose not only prolongs the vase life but also improves the length and visible color of the inflorescence. A steady supply of sucrose in the vase solution can lead to a full 100% opening rate of flower heads. Specifically, a combination of 200 ppm citric acid with 4% sucrose was found to be effective in extending the vase life of gladiolus flowers. Further studies revealed that a mixture of 4% sucrose and 100 ppm cobalt sulfate ($CoSO_4$) resulted in a prolonged vase life of 12.3 days and a maximum blooming period of 22.3 days.

In another instance, applying sucrose for 8 hours to Vriesea incurvata Gaudich (from the Bromeliaceae family) enhanced the preservation of color, brightness, and turgidity of the floral scapes, maintaining a better water balance, reducing fresh weight loss, and extending the vase life by up to 24 days. Moreover, combining sucrose with cobalt chloride or silver nitrate improved water balance in spikes and extended the vase life further. Cobalt chloride was particularly effective in preventing vascular blockages caused by bacterial growth in the flower stems. The use of cobalt chloride ($CoCl_2$) on iris spikes also demonstrated a significant extension of their vase life by preventing blockages in vascular tissues.

Effect of Growth Regulators on Physiological Parameters

Sable et al.investigated the effects of foliar application of plant growth regulators on the gladiolus cultivar H.B. Pitt. Corms treated with Bavistin (0.1%) and plants sprayed with various concentrations of GA_3 (Gibberellic Acid), NAA (Naphthalene Acetic Acid), and CCC (Chlormequat Chloride) revealed that GA_3 at 200 ppm was particularly effective. This concentration promoted cell elongation, increased internodal length, enhanced plant height, and boosted the number and weight of florets, significantly improving the overall growth and quality of the flowers.

Similarly, Padmalatha et al.conducted a study on two gladiolus cultivars, Darshan and Dhiraj, to evaluate the impact of foliar application of Boron (10 ppm) combined with GA_3 (150 ppm). The treatment at the 3rd and 6th leaf stages resulted in a significant increase in the number of corms and cormels, as well as enhanced weight and size of the corms. This combination was suggested for the multiplication of high-quality planting material and for extending the vase life of gladiolus flowers. Overall, the use of Gibberellic Acid (GA_3) on gladiolus corms has been shown to be an effective strategy for breaking dormancy, enhancing vegetative growth, and improving flower quality. This treatment also contributes to the enlargement of corms and cormels, making it a valuable practice in gladiolus cultivation for better yield and quality improvement.

Conclusion

Gladiolus is a highly sought-after cut flower globally. However, its perishable nature poses challenges to its vase life, especially as the gladiolus industry continues to expand. The growing demand highlights the need for advanced research and the development of innovative technologies to tackle the rapid decline in the post-harvest life of gladiolus flowers. Implementing the discussed strategies has demonstrated potential in effectively extending the vase life, thereby enhancing the flower's longevity and market value.

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