GreenariA
Go Green, Learn Green
An Agricultural Monthly e-Magazine

Volume 04, Issue 03, 2026
ISSN: 2584-153X
Article ID: G-26-0307

CLIMATE-RESILIENT FLORICULTURE CROPS UNDER CHANGING CLIMATE SCENARIOS: A COMPREHENSIVE REVIEW

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Abstract

Climate change has emerged as a major challenge to floriculture production due to increasing temperatures, irregular rainfall patterns, frequent droughts, floods and altered pest and disease dynamics. Floriculture crops are particularly vulnerable to climatic variability because flower initiation, development and quality are highly influenced by environmental conditions. Climate-resilient floriculture emphasizes the selection of stress-tolerant crops, adoption of adaptive cultivation practices and efficient resource management to sustain flower production under changing climate scenarios. Several flower crops such as marigold, chrysanthemum, tuberose, zinnia, gaillardia, vinca, protected-cultivated orchids and anthurium hybrids have demonstrated greater tolerance to abiotic stresses. This review summarizes the impacts of climate change on floriculture, identifies climate-resilient flower crops and discusses adaptive strategies and future prospects for sustainable floriculture.

Keywords: Climate change, floriculture, climate resilience, abiotic stress and sustainable flower production.

Introduction

Floriculture is an economically important component of horticulture, contributing to employment generation, export earnings and landscape aesthetics. However, climate change has increasingly threatened the sustainability of floriculture systems worldwide. Rising temperatures, unpredictable rainfall and extreme weather events adversely affect flower yield, quality and marketability.

Since most floricultural crops have narrow climatic requirements, even slight environmental deviations can result in physiological stress and yield losses. Therefore, developing climate-resilient floriculture systems has become a priority for ensuring long-term sustainability and economic stability (IPCC, 2021; Sharma *et al*., 2020).

Impact of Climate Change on Floriculture Crops

Climate change influences floriculture crops through both direct and indirect effects. Elevated temperatures accelerate crop phenology, reduce flower size and shorten vase life, while drought stress impairs water uptake and photosynthesis. Excess rainfall and flooding increase the incidence of root rot and nutrient leaching.

In addition, changing climatic conditions favor the proliferation of insect pests and vector-borne diseases, further increasing production risks. These combined stresses significantly reduce flower quality and yield, affecting growers profitability (Hatfield and Prueger, 2015; FAO, 2018).

Concept of Climate-resilient Floriculture

Climate-resilient floriculture refers to the capacity of flower crops and production systems to withstand climatic stresses, adapt to changing conditions and recover from extreme events without significant yield loss. This resilience is achieved through genetic tolerance, physiological adaptability and improved agronomic management. The approach integrates climate-smart practices such as efficient water use, protected cultivation and stress-tolerant varieties to reduce vulnerability and enhance system stability (FAO, 2018; Ray *et al*., 2013).

Climate-resilient floriculture crops

Heat and drought tolerant crops

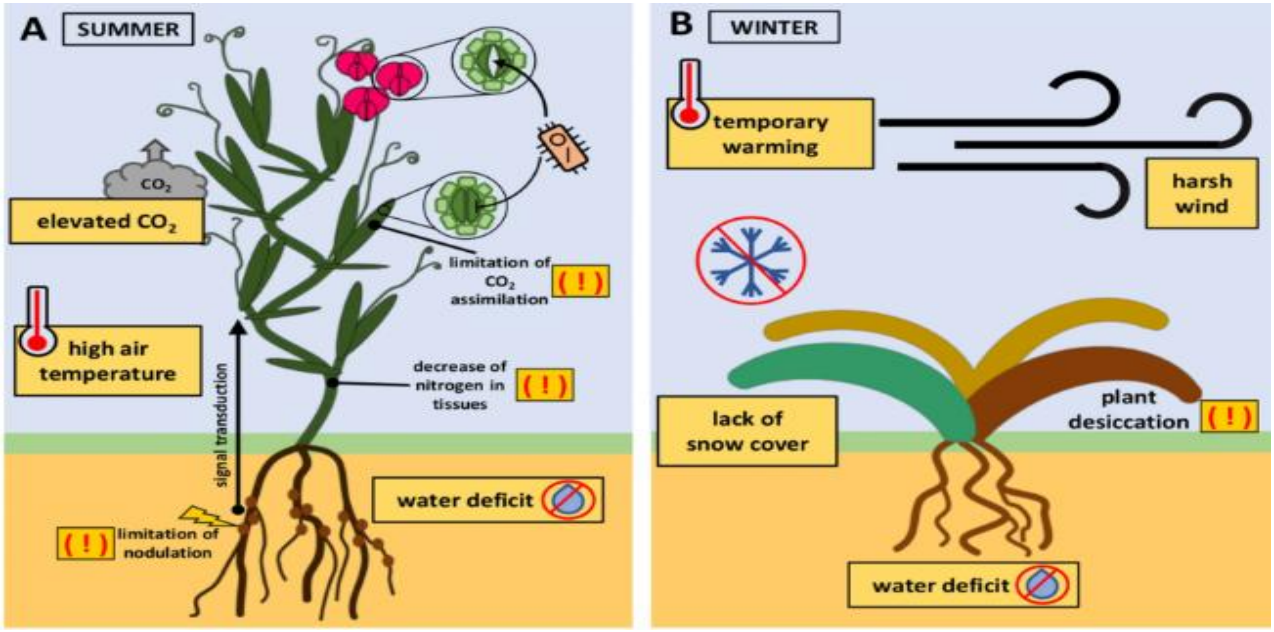
Several annual and perennial flower crops exhibit tolerance to high temperature and limited moisture availability. Marigold (*Tagetes spp.*), zinnia (*Zinnia elegans*), gaillardia (*Gaillardia pulchella*) and vinca (*Catharanthus roseus*) maintain growth and flowering under heat and drought stress due to efficient water use and stress-adaptive traits. These crops are well suited for cultivation in semi-arid and arid regions under climate-stressed conditions (Sharma *et al*., 2020).

Moisture and humidity-tolerant crops

Chrysanthemum and tuberose exhibit moderate tolerance to variable moisture conditions when managed with proper drainage and nutrition. These crops can adapt to fluctuating rainfall patterns and are suitable for regions experiencing irregular precipitation. However, integrated disease management is essential to prevent moisture-induced diseases under humid environments (Hatfield and Prueger, 2015).

Protected cultivation-based crops

High-value floriculture crops such as orchids, anthurium, gerbera and carnation show improved resilience when cultivated under protected structures like polyhouses and shade nets. Controlled environments help regulate temperature, humidity and light, thereby reducing exposure to climatic extremes and ensuring consistent flower quality and yield (FAO, 2018).



Physiological adaptations to climate stress

Climate-resilient floriculture crops exhibit adaptive physiological mechanisms such as deeper root systems, enhanced stomatal regulation, osmotic adjustment and increased antioxidant activity.

These traits enable plants to maintain cellular stability, photosynthetic efficiency and reproductive development under abiotic stress conditions. Understanding these mechanisms is crucial for breeding and selection of stress-tolerant flower crops (Hatfield and Prueger, 2015).

Management strategies for climate-resilient floriculture

Adaptive management practices play a key role in enhancing climate resilience. These include the use of stress-tolerant cultivars, protected cultivation, precision irrigation systems, mulching, organic amendments and application of biostimulants.

Integrated pest and disease management further reduces climate-induced biotic stress. Together, these strategies improve resource-use efficiency and stabilize flower production under variable climatic conditions (FAO, 2018; Sharma *et al*., 2020).

Economic and environmental benefits

Adoption of climate-resilient floriculture practices enhances yield stability, reduces crop failure risk and improves farmers' income security. Environmentally, these practices promote efficient water use, reduce chemical dependency and enhance soil health.

Climate-resilient systems also contribute to reduced greenhouse gas emissions and improved ecosystem sustainability (Ray *et al*., 2013; IPCC, 2021).

Research Gaps and Future Prospects

Despite progress, further research is required to develop region-specific climate-resilient flower varieties and refine adaptive management practices. Future studies should focus on molecular breeding for stress tolerance, integration of climate forecasting with crop planning and expansion of affordable protected cultivation technologies. Strengthening research extension linkages will be essential for large-scale adoption of climate-resilient floriculture (IPCC, 2021; Sharma *et al*., 2020).

Conclusion

Climate change poses a serious threat to floriculture production, but the adoption of climate-resilient crops and adaptive management strategies can significantly mitigate its adverse impacts. Promoting climate-resilient floriculture is essential for sustaining flower production, ensuring economic stability and supporting environmental sustainability under changing climate scenarios.

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