

## Impact of Climate Change on Floricultural Crop Production

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### INTRODUCTION

Climate change has emerged as one of the most critical global challenges affecting agricultural and horticultural systems. Floriculture, an intensive and highly specialized branch of horticulture, is particularly vulnerable due to its sensitivity to temperature, humidity, photoperiod, and water availability. Rising temperatures, unpredictable rainfall, increased CO<sub>2</sub> concentration, and frequent extreme weather events influence the growth, flowering behavior, pest and disease incidence, and overall productivity of floricultural crops. Climate change alters phenology, reduces flower quality, affects pigment formation, and disrupts pollination mechanisms. The ornamental industry, which depends heavily on consistent quality and year-round supply, faces significant risk as environmental fluctuations threaten both open-field and protected cultivation. Understanding these impacts is essential for developing adaptive strategies to sustain the global floriculture sector. This article examines major climate factors influencing floricultural crops and explores mitigation and adaptation approaches to ensure resilient production.

### Impact of Rising Temperature

Temperature is one of the primary environmental factors influencing floral initiation, pigment synthesis, growth rate, and post-harvest life. Global warming has caused a marked rise in average temperatures, which accelerates plant metabolism and alters flowering duration. High temperatures often result in shorter flower stems, poor bud formation, leaf scorching, and reduced pigment intensity in sensitive crops like roses, gerbera, chrysanthemum, and carnation. Heat stress disrupts enzyme activity essential for anthocyanin biosynthesis, leading to faded colours and reduced market quality. Some species exhibit flower drop or failure of bud opening when exposed to prolonged heat waves. In protected structures such as polyhouses, elevated internal temperatures further intensify heat stress unless proper ventilation systems are installed. Excessive heat also increases respiration rate, reducing carbohydrate availability and shortening vase life. As climate models predict continued warming, heat-tolerant cultivars and advanced cooling systems will be crucial for ensuring sustainable floricultural production.

**Table: Floricultural Crops**

| S.No | Flower Crop   |
|------|---------------|
| 1    | Rose          |
| 2    | Gerbera       |
| 3    | Chrysanthemum |
| 4    | Carnation     |
| 5    | Marigold      |
| 6    | Gladiolus     |
| 7    | Tuberose      |
| 8    | Jasmine       |
| 9    | Orchids       |

### Effect of Irregular Rainfall and Water Stress

Climate change has intensified rainfall variability, resulting in unpredictable droughts and floods. Floricultural crops require precise irrigation schedules, and deviations can severely affect growth and flower quality. Water deficit stress leads to reduced cell expansion, smaller flowers, poor branching, and decreased yield in species like marigold, gladiolus, tuberose, and jasmine. Drought conditions trigger stomatal closure, limiting photosynthesis and hindering plant growth. Conversely, excessive rainfall causes waterlogging, root rot, nutrient leaching, and fungal diseases, which reduce plant vigour and flower longevity. Seasonal flower crops that depend on monsoon patterns face uncertain transplanting and harvesting windows. Water stress also affects pigment stability and essential oil production in aromatic ornamentals. As extreme rainfall events become more common, adoption of micro-irrigation, rainwater harvesting, soil moisture monitoring, and well-designed drainage systems become vital for climate-resilient floriculture.

### Changes in Pest and Disease Dynamics

Climate change significantly influences pest and disease patterns in Floricultural ecosystems. Warmer temperatures and higher humidity favour rapid multiplication of insects such as aphids, thrips, whiteflies, and mites—major pests of roses, chrysanthemums, gerbera, and orchids. Many pathogens, particularly fungal species, spread faster under fluctuating temperatures and increased moisture levels. Diseases like powdery mildew, downy mildew, rust, and botrytis

become more prevalent during climate anomalies. Shifting weather patterns also extend the geographic distribution of pests, introducing new threats to previously unaffected regions. Increased pest pressure demands higher pesticide use, raising production costs and environmental risks. Farmers must adopt integrated pest management (IPM), biological control agents, resistant cultivars, and climate-smart crop scheduling to protect crop health under changing climatic scenarios.

### Impact on Flowering Behavior and Quality

Flowering in ornamental plants is highly sensitive to climatic conditions such as temperature, photoperiod, and humidity. Climate change disrupts these cues, leading to irregular or delayed flowering, reduced flower size, incomplete bud development, and poor coloration. High night temperatures negatively affect floral induction in crops like carnation and chrysanthemum, while heat stress shortens flowering duration in rose and marigold. Increased CO<sub>2</sub> concentration stimulates vegetative growth but may reduce reproductive output in some species. Flower quality traits—such as fragrance, colour intensity, petal thickness, and vase life—are compromised by climate-induced stress. Pigment biosynthesis pathways, particularly anthocyanins and carotenoids, are temperature-sensitive and often produce dull or uneven pigmentation under unfavourable conditions. This results in reduced market value, especially for premium cut flowers. Adopting controlled environment production, photoperiod manipulation, and climate-proof cultivars can help maintain quality.

### Adaptation and Mitigation Strategies

To sustain floricultural crop production amid climate change, several adaptive and mitigation strategies must be implemented. Protected cultivation technologies such as shade nets, greenhouses, and polyhouses provide controlled microclimates and help regulate temperature, humidity, and light. Drip irrigation, fertigation, and soil moisture sensors optimize water use efficiency, reducing drought risk. Breeding climate-resilient varieties with tolerance to heat, drought, and emerging pests is essential for future production systems. Integrated nutrient management improves soil health and enhances plant resilience. Use of mulching, organic amendments, and biofertilizers reduces environmental stress. Weather-based advisory systems and early warning tools help farmers plan crop schedules. Renewable energy solutions such as solar-powered irrigation and greenhouse cooling reduce carbon footprint. Collectively, these practices strengthen climate resilience and ensure stable production of high-quality flowers even under unpredictable climate conditions.

### CONCLUSION

Climate change poses multifaceted challenges to the global floriculture industry, affecting growth patterns, flowering behaviour, pest dynamics, and overall productivity. The sensitivity of ornamental crops to environmental fluctuations makes them particularly vulnerable. However, through scientific research, improved cultivation practices, advanced technology, and climate-

resilient varieties, it is possible to mitigate adverse impacts and sustain floricultural production. Strengthening adaptive capacity at the farm level and integrating climate-smart strategies will ensure the continued growth of the floriculture sector in a changing world.

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