

Research Insight

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Effects of Drought Stress on Photosynthesis and Water Use Characteristics of *Chrysanthemum morifolium*

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Abstract *Chrysanthemum morifolium* is an important medicinal and ornamental crop with high economic value; however, its growth and productivity are increasingly threatened by drought stress caused by climate change and limited water availability. Drought stress directly affects plant water balance, photosynthetic performance, carbon assimilation, and water use efficiency, thereby limiting biomass accumulation and flower yield formation. This review systematically summarizes the effects of drought stress on photosynthesis and water use characteristics of *C. morifolium*, with emphasis on physiological, biochemical, and molecular regulation mechanisms. Under drought conditions, reduced soil moisture availability induces declines in leaf relative water content, stomatal conductance, transpiration rate, and net photosynthetic rate, resulting from both stomatal limitation and non-stomatal inhibition. Meanwhile, drought stress alters chlorophyll metabolism, damages photosystem II activity, and affects electron transport efficiency, leading to reduced light energy conversion capacity and carbon fixation efficiency. To cope with water deficiency, *C. morifolium* plants employ multiple adaptive strategies, including stomatal regulation, osmotic adjustment through accumulation of proline and soluble sugars, enhancement of antioxidant defense systems, and modulation of drought-responsive gene expression. Changes in water use efficiency reflect the trade-off between carbon gain and water conservation, providing important indicators for evaluating drought adaptation. A case study approach is presented to analyze the dynamic responses of photosynthetic parameters and water use traits under different drought intensities, identifying key physiological indicators associated with drought tolerance. Furthermore, this review discusses practical strategies for improving drought resilience, including optimized irrigation management, application of soil amendments and biostimulants, and development of drought-tolerant cultivars through molecular breeding. Future integration of multi-omics technologies, high-throughput phenotyping, and intelligent irrigation systems will provide new approaches for enhancing water-saving production and sustainable cultivation of *Chrysanthemum morifolium* under increasingly variable climatic conditions.

Keywords *Chrysanthemum morifolium*; Drought stress; Photosynthetic characteristics; Water use efficiency; Drought adaptation mechanisms

1 Introduction

Chrysanthemum morifolium is a globally important horticultural crop with substantial ornamental, economic, ecological, and medicinal value. As one of the world's leading ornamental flowers and among the most valuable cut flowers in international floriculture, *Chrysanthemum* supports commercial production as cut flowers, potted plants, and landscape ornamentals across diverse cultivation systems (Luo et al., 2023). Beyond its ornamental role, *C. morifolium* has long been used as a medicinal and food-homology plant in East Asia, where its dried capitula and related products are valued in traditional medicine, tea, and functional foods because of their rich flavonoids, phenolic acids, volatile oils, polysaccharides, and other bioactive compounds (Hao et al., 2022; Liu et al., 2024). This dual-use identity means that stable *Chrysanthemum* production is important not only for the flower industry, but also for the sustained supply of plant material with nutritional and pharmacological relevance. As a result, environmental stresses that reduce biomass, flowering quality, or phytochemical accumulation can diminish both commercial value and downstream medicinal utility.

Among abiotic constraints, drought is one of the most serious factors limiting *Chrysanthemum* growth, production, and market performance. Studies consistently show that water deficit reduces plant growth and flower yield,