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Editorial

Ornamental Plant Physiology and Molecular Biology

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1. Introduction

Ornamental plants not only beautify our environment, thanks to their vivid colors and diverse forms, but also play a vital role in agriculture, industry, and medicine, reflecting significant scientific and economic value. However, the genetic and physiological complexities that contribute to their unique characteristics are often underexplored.

This Special Issue, titled "Ornamental Plant Physiology and Molecular Biology", seeks to elucidate the underlying mechanisms governing the growth, development, and stress responses of ornamental plants. It presents a carefully selected collection of research papers that spotlight cutting-edge advances in the field. The topics covered include novel insights into alterations in flower color and scent, the development and utilization of ornamental flowers, and environmental adaptation regulation. Our aim in publishing this Special Issue is to emphasize this collection's importance and potential to enhance our understanding of ornamental flower physiology and molecular biology, alongside their applications in horticulture.

2. Floral Color in Ornamental Plants

Flower color is a key trait that attracts pollinators in nature and captivates human interest, significantly influencing the ornamental plant industry. The diverse palette of colors displayed by flowers is not merely a visual delight; it signifies a complex interaction of genetics, environmental factors, and evolutionary processes [1,2]. Advances in biotechnology have deepened our understanding of the molecular mechanisms underlying flower color. Through the manipulation of genetic and biochemical pathways, scientists can now introduce novel hues and patterns into ornamental plants, enhancing their appeal and marketability. Techniques such as mutagenesis, induced by gamma rays and X-rays, have enabled the creation of new chrysanthemum varieties with minimal impact on plant health, promoting sustainable horticultural practices (contribution 1).

Transcriptomic and metabolomic integration play critical roles in exploring flower color, offering valuable clues for enhancing color modification breeding programs [3]. By examining the expression and metabolic profiles of different *Rhododendron liliiflorum* petal colors, researchers can identify the genes and compounds responsible for these variations, which are crucial for developing new plant varieties with desirable traits (contributions 2 and 3).

Furthermore, research on leaf color variation in *Primulina serrulata* provides insights into different aspects of plant pigmentation. Proteomic analyses have shown how variations in leaf coloration, especially the species' distinctive white markings, are linked to alterations in chloroplast biosynthesis and photosynthesis. These findings highlight the potential for targeted genetic and cultivation strategies to enhance leaf variegation, adding another layer of value to ornamental plants (contribution 4).

Collectively, these research endeavors significantly enrich our understanding of ornamental plant pigmentation, guiding the breeding of new esthetically pleasing varieties.

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3. Floral Scent in Ornamental Plants

Floral scent has long been integral to human culture and commerce, serving roles beyond mere esthetic appeal. Floral fragrances facilitate vital interactions between plants and pollinators [4,5], while also being exploited across various industries, including perfumery and pharmaceuticals, highlighting their significance in both natural and man-made environments.

Research on species like *Iris uniflora*, *Iris typhifolia*, and *Iris sanguinea* has identified specific aromatic compounds, such as terpenes and sulfur-containing molecules, that contribute to their alluring fragrances and medicinal properties, thus enhancing their economic value. These discoveries underscore these compounds' potential to aid in improving food flavor profiles, developing new pharmaceutical applications, and crafting sophisticated fragrances (contribution 5).

In studies on ornamental and medicinal plants like *Dendrobium*, genetic pathways critical for scent production, particularly those involved in terpene synthesis, have been mapped. Genes encoding linalool synthase play a vital role in producing rich, complex scents. Understanding these genetic pathways facilitates the breeding of new plant varieties with customized aromatic profiles, presenting exciting opportunities for agricultural, horticultural, and commercial applications (contribution 6).

4. Nutritional Development and Utilization of Ornamental Plants

Ornamental plants are renowned for their esthetic value, enhancing landscapes and enriching our living spaces with their vibrant colors and scents. However, their significance extends beyond visual beauty, as many of these plants also possess substantial nutritional and medicinal properties that have been utilized in various cultures for centuries [6]. In ornamental plants, flower development is not only a key aspect of their reproductive cycle but also a critical phase during which significant biochemical transformations take place. These transformations often result in accumulating valuable phytochemicals, such as anthocyanins, which have well-documented health benefits. Understanding these processes can lead to a more effective use of ornamental plants in the food and pharmaceutical industries [7].

For instance, *Cercis chinensis* is valued not only for its striking flowers but also for its role in traditional medicine. These flowers are rich in anthocyanins, serving as a natural source of red pigments widely used in the food industry. Ongoing research focuses on the nutritional and antioxidative changes occurring during the flower development of *C. chinensis* to optimize harvest times and maximize the extraction of these functional components for broader applications in pharmaceuticals and food products (contribution 7).

Similarly, *Michelia maudiae 'Rubicunda'*, known for its esthetic and aromatic qualities, contains a rich array of nutrients crucial for flower development. Research into hormonal balances such as ABA, GA3, and CTK during the flowering stages of *M. maudiae* provides valuable insights into flower bud differentiation and physiological mechanisms. This knowledge not only deepens our understanding of plant biology but also aids in breeding new varieties with optimized characteristics for both decorative and practical uses (contribution 8).

5. Adaptive Strategies of Ornamental Plants against Environmental Stress

Ornamental plants are widely appreciated for their visual appeal, yet beneath this beauty lies a complex array of adaptive strategies that enable them to thrive under environmental stresses. These adaptations are crucial not only for the survival of the plants but also for preserving their ornamental value in landscapes facing diverse climatic challenges. Understanding these strategies is essential for optimizing horticultural practices and enhancing plant resilience in natural and cultivated environments. For instance, in response to drought, plants can adapt through physical modifications, biochemical adaptions, hormonal regulation, and transcriptional reprogramming [8,9]. Recent research has illumi-

nated the genetic and physiological mechanisms that ornamental plants utilize to manage adverse conditions. For example, studies on *Heimia myrtifolia* have identified specific genes responsible for drought tolerance, providing insights into the molecular foundations that support this sun-loving shrub in conditions of water scarcity (contribution 9). Similarly, research on *Impatiens uliginosa* has shown that environmental stressors like elevated copper levels can induce significant changes in petal coloration by altering pigment biosynthesis genes (contribution 10).

Additionally, research on Crassulacean Acid Metabolism (CAM) in plants highlights a significant evolutionary adaptation to arid conditions. CAM plants, including many ornamental varieties, demonstrate an impressive ability to switch between C3 and CAM photosynthesis, facilitating efficient water usage and improved drought tolerance. This photosynthetic flexibility not only aids plant survival during water deficits but also preserves their esthetic qualities, making them especially valuable in drought-prone areas (contribution 11).

The exploration of these adaptive strategies enriches our understanding of plant resilience and assists in the development of robust ornamental plants that can maintain their beauty and functional roles in landscapes despite environmental challenges.

6. Conclusions

This Special Issue on "Ornamental Plant Physiology and Molecular Biology", collating exciting new research on aspects ranging from flower color variations, scent profiles, nutritional content, and resilience to environmental stresses, provides fundamental insights into the genetic and molecular mechanisms driving these traits. The advancements discussed herein not only deepen our understanding of plant biology but also offer practical applications that can lead to the development of more robust and visually appealing plant varieties fulfilling both commercial and ecological demands.

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