

EDITORIAL

Reflection on new avenues for research and practice in ornamental horticulture: perspectives for innovation, sustainability and sector application

Reflexão sobre novas pesquisas e práticas em horticultura ornamental: perspectivas para inovação, sustentabilidade e aplicação no setor.

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Scientific and technological advances have been primarily responsible for the diversification and improvement in the quality of flower and ornamental plant production in Brazil and around the world. The introduction of new technologies and management practices allow to increase the number of species cultivated and, above all, to improve the quality of those already in production. These topics have been highlighted in the articles published in Ornamental Horticulture, addressing crucial aspects aimed at optimising production, quality, sustainability, genetic conservation, and economic viability of various species of flowers and ornamental plants.

Considering aspects of genetics, taxonomy, and conservation, comparative studies conducted on *Alstroemeria werdermannii* plants confirmed that the varieties share the same karyotype, despite morphological and distribution differences (Baeza et al., 2025). Similarly, genomic and karyotypic analyses of diploid and tetraploid varieties of desert rose (*Adenium obesum*) suggest that these are distinct taxonomic entities, not just varieties (Rosa et al., 2025). In another analysis, a comparison of the reproductive biology of diploid and triploid cytotypes of *Passiflora foetida* identified triploids regenerated from *in vitro* endosperm cultures (Barros et al., 2025).

The use of molecular markers is an important technique for plant breeding and the production of new species, such as advances in the floriculture and ornamental plant segment. Thus, the application of SSR markers is important for assessing genetic diversity in native carnivorous plant species of the genus *Nepenthes* (Sontikun et al., 2025), while SRAP markers can be used to analyse genetic diversity in zinnia (*Zinnia elegans*) accessions (Sari et al., 2025). Another application of ISSR is for the detection of genetic (somaclonal) variation in callus cultures of *Etilingera elatior* (Rosli et al., 2025). To support the development of other technologies, the use of morphological markers for microsporogenesis and microgametogenesis provides an important basis for *in vitro* culture techniques of anthers or microspores for the genetic improvement of *Adenium obesum* (Campos et al., 2025).

For plant conservation, the development of cryopreservation protocols for orchids *Oncidium baueri* (Suzuki et al., 2025) and for the carnivorous species *Drosera schwaackei* (Alves et al., 2025) represents significant advances. Focusing on native Brazilian species with untapped potential, conservation and production studies of *Vanilla bahiana* and *Vanilla pompona* enabled the establishment of viable techniques for these species (Nadal et al., 2025). In *Vanilla planifolia*, studies of different pollination schemes on the morphometry characteristics of the fruits (Fernández-Villa et al., 2025) introduced important information to support future genetic breeding programmes for the species.

The study on research trends with emphasis on heliconias revealed that plant biotechnology is the main technique used (Hernández-Chontal et al., 2025). The optimisation of tissue culture protocols is essential for mass propagation and overcoming limitations of important species, such as chrysanthemum (*Chrysanthemum morifolium*) (Winarto et al., 2025);

ornamental banana (*Musa* spp. 'Pink Nono') (Siregar et al., 2025) and zamioculca (*Zamioculcas zamiifolia*) (Ashouri et al., 2025), generating information to support commercial-scale production, thus meeting industry demands (Paiva et al., 2024). *In vitro* propagation has also been investigated for native woody and fruit species with ornamental potential, such as the Rio Grande cherry tree (*Eugenia involucrata*), seeking to optimise germination and seedling development (Júnior et al., 2025). To enable the advancement of production processes for species with new uses in the market, *in vitro* techniques for the propagating and improvement of edible flowers are of great importance for these species, used for a significant number of species (Paiva et al., 2025). In parallel, the evaluation of rose cultivars (*Rosa hybrida*) for edible flowers considered antioxidant capacity, nutritional value, and organoleptic properties, indicating that they are rich in nutritious compounds (Pourzarnegar et al., 2025). The analysis of Persian yellow rose (*Rosa foetida*) and dog rose (*Rosa canina*) highlighted the valuable properties of their bioactive compounds (Nazari et al., 2025).

The evaluation of aesthetic characteristics and flower durability, associated with the use of sustainable practices, is a premise of pre- and post-harvest management studies. Thus, the use of growth regulators such as paclobutrazol aligns with research that used biostimulants and growth regulators to manipulate development, flowering, and post-harvest quality of ornamental sunflower (Santos et al., 2025). The management of post-harvest longevity in *Hemerocallis fulva* has shown that the application of melatonin, a potent growth regulator, is effectively in delaying senescence (Lone et al., 2025). The effectiveness of biostimulants such as fulvic acid in *Alstroemeria* (Sahraie et al., 2025) in promoting greater flower longevity and the use of humic acid and CPPU in marigold (*Tagetes erecta*) (Al-Dulaimy et al., 2025) as strategies for improving ornamental plant production have also been identified. Similarly, the use of humic acid was also effective in São Carlos grass (Watanabe et al., 2025), and the application of carbon nanoparticles improved seedling development in anthurium (Silva et al., 2025). Foliar application of biostimulants has been shown to be the most efficient in promoting growth in lisianthus (*Eustoma grandiflorum* L.) and stock (*Matthiola incana* L.) (Ahmad et al., 2025). Cerium (Ce) has also been identified as a promising inorganic biostimulant to improve post-harvest quality in tulips (Gómez-Navor et al., 2025).

Strategies to prolong vase life include the use of salicylic acid to mitigate oxidative stress in tiger lily (*Lilium tigrinum*) (Aftab et al., 2025), heat treatments with hot water to delay senescence in *Lilium longiflorum* (Mantilla et al., 2025), and the microalgae *Chlorella* sp. as a preservative for cut sunflower (Taira et al., 2025). On the other hand, the occurrence of negative effects of eucalyptus essential oil in the post-harvest of calla lily (*Zantedeschia aethiopica*) highlight the need for caution when adopting eco-friendly solutions (Salgado et al., 2025). New insights into floral development and stem longevity provided valuable information for *Ornithogalum saundersiae* conservation (Streck et al., 2025).

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In the production of flowers and ornamental plants, the development and improvement of management techniques is essential for optimise production processes. The use of integrated management practices combining growth inhibitors and promoters to achieve more sustainable and efficient lawn management was highlighted (Curk et al., 2025). In terms of nutrition, a study on the requirements of *Dendrobium bigibbum* orchids revealed that the species is sensitive to macronutrient deficiencies (N, P, K, Mg, S) (Meireles et al., 2025). Optimising the supply of nutrients, such as phosphorus, promoted early flowering and increased antioxidant capacity in the black orchid (*Coelogyne pandurata*) (Heriansyah et al., 2025), whereas different calcium sources improved vase life and nutritional status of rose cultivars (Khosravi et al., 2025).

Obtaining ornamental plants with high commercial standard is directly associated with seedling quality. Thus, inoculation with growth-promoting rhizobacteria represents a biotechnological strategy capable of optimising physiological and morpho-anatomical processes, resulting in greater uniformity, vigour, and performance in plant establishment (Campos et al., 2023), such as the rhizobacterium *Bacillus subtilis*, which has shown potential to accelerated emergence and promote superior growth, and flowering in zinnia (Silveira et al., 2025). Biopriming with endophytic isolates of *Beauveria bassiana* enhanced *Begonia rex* seedling development during *ex vitro* acclimatisation (Fershalova et al., 2025), and the use of plant growth-promoting bacteria combined with silicon (Si) improved the performance of emerald grass (Girardi et al., 2025).

Optimising production in different environments and managing resources includes minimising stress factors in plants, such as water deficit in cut sunflower production. The FATS (Fraction of Transpirable Soil Water) methodology is a valuable tool for sustainable water management (Simon et al., 2025). Studies and the selection of drought-tolerant ornamental species, together with a better understanding of their physiological and biochemical mechanisms, can contribute to increasing their productivity in arid and semi-arid environments, as described in the article that evaluated drought tolerance in various petunia genotypes (Cheheltanan et al., 2025). Environmental conditions are decisive and influence the post-harvest quality and longevity of ornamental plants. The appropriate choice of planting date is essential to align the reproductive phase with ideal environmental conditions, ensuring higher commercial quality in freesia flower stems (Santilli et al., 2025). Considering water supply and the cultivation of roses in hydroponics, the use of the ebb and flow system allowed for optimising irrigation frequency, in addition to determining the nutrient solution to provide flower production with commercial quality standards and better population management of undesirable and beneficial arthropods (Campos et al., 2025). In the cultivation of cut dahlias (*Dahlia variabilis*), it was observed that prolonged exposure to low temperatures intensified frost damage, compromising reproductive structures. Adaptive management strategies are recommended, such as the use of low polyethylene tunnels, thermal covers, sprinkler irrigation, plastic mulch, selection of cold-tolerant cultivars, and adjustment of the planting dates to avoid critical periods (Fernandes et al., 2025).

Technological innovations play a central role in advancement of the flower and ornamental plant production sector (Cunha Neto et al., 2023). These advances not only improve the efficiency of production systems but also establish new perspectives for development of sustainable strategies in the ornamental market. Floating floriculture was presented as a technique for growing marigolds in polluted wetlands, transforming water bodies into productive and aesthetically valuable environments (Imran et al., 2025). Another important technique was the use of UV-C light irradiation, which proved to be an effective and sustainable alternative to chemical fungicides for controlling *Botrytis cinerea* in cut roses (Espejel-

Maycotte et al., 2025). Supplemental lighting with LEDs proved to be a profitable and lower energy cost alternative for cultivation of *Aster* sp. and *Solidago canadensis* (Castillo et al., 2025). And the use of pots promoted savings and sustainability without compromising the growth of purslane (*Portulaca oleracea*) (Silva et al., 2025).

The analysis of socio-environmental aspects allows for significantly contributions to quality of life and sustainable practices in the area of ornamental horticulture, highlighting the role of cut sunflower as an alternative source of income for small farmers in Southern Agreste region of Pernambuco (Alves et al., 2025).

An analysis of green infrastructure in cycle paths in Rio de Janeiro, including cyclists perception of benefits and challenges posed by plant species used in landscaping, aimed to take an approach to urban ecological landscaping (Ferraz et al., 2025). Research on the planning and evaluation of rooftop gardens projects showed that flowering herbaceous plants were the most preferred plant component (Abdelnaby et al., 2025). Analyses of the physical properties of ubim palm seeds (*Geonoma deversa*) provided information on their potential use in urban landscaping (Carvalho et al., 2025).

In the context of marketing, the study of the social learning model for ornamental plant producers highlighted the effectiveness of social media in approaches aimed at overcoming digital literacy challenges and expanding digital marketing (Nurfathiyah et al., 2025). The use of Google Trends data as a practical and economical digital tool allows for the anticipation of trends in global flower markets and supports strategic decisions (Andrade et al., 2025).

Thus, the advances reported in the published articles demonstrate that important contributions have been made in different fields and areas of research involving flowers and ornamental plant. However, it is still understood that there are demands and problems to be elucidated. Among the topics deserve future attention are the applications and limitations of artificial intelligence for breeding, management, and market prediction; the development and improvement of post-harvest technologies to extend the shelf life and quality of flower stems; and progress in more effective and sustainable biological control strategies for pest and disease management. These topics represent important frontiers for the sector and can significantly contribute to innovation and competitiveness across the ornamental production chain.

Author contribution

FCN: Conceptualization, Editorial handling, Writing – review & editing. PDOP: Conceptualization, Editorial handling, Writing – review & editing.

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