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Editorial

The State-of-the-Art Propagation and Breeding Techniques for Horticulture Crops

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Horticulture has established its importance in many aspects including innovation, improving land use, promoting crop diversification, generating employment, and providing food to the world population. Thus, innovation in plant propagation and breeding is essential to meet the challenges of global changes such as population growth and climate change [1].

Over the years, horticulturists have developed several propagation methods which have supported breeding programs and allowed the production of high-quality nursery plants and higher yielding crops. Traditional breeding is one of the main strategies used to improve agronomic traits. In many horticultural species, several cultivars have been developed through conventional methods, such as mutagenesis, inter- and intra-specific crosses, and clonal selection. Conventional breeding is a long-term and expensive process; a long period of time and resources are needed to obtain progenies and to evaluate their traits. In addition, sexual breeding is not always feasible because some cultivars to be used in crosses are incompatible, sterile, or polyembryonic. Moreover, in many cases, after breeding, backcrosses are required to recover the desired features of the improved cultivar, further lengthening breeding programs [2].

Since the 1990s, new biotechnology techniques have been applied to the propagation and breeding of horticultural species, providing efficient alternatives to traditional methods for the improvement of novel cultivars. This has been possible through the development of transformation protocols starting from many sources of explants. More recently, several new techniques have been developed and classified as new plant breeding techniques. The aim of this Special Issue was to present the latest advances in new horticultural propagation and breeding methods.

The Special Issue "The State-of-the-Art Propagation and Breeding Techniques for Horticulture Crops" brings together some of the latest research results of new techniques in this field. It presents twelve original papers, which deal with a wide range of research activities.

Vendrame et al. [3] examined the growth response of ornamental bananas, Musa 'Little Prince' and Musa 'Truly Tiny', to different light sources, including LEDs and regular fluorescent light. The authors found that shoot mass and length could be promoted by controlling light quality and intensity. However, the effect of light quality and intensity related to plant growth and development were not evident. Although not directly evaluated in this study, the number of in vitro shoots produced per explant were higher for some of the cultures grown under the LED lights, with multiple shoots produced, while no shoots were formed in cultures grown under regular fluorescent lighting. The different responses between the two banana cultivars indicated a genotype effect in combination with different light environments. LED lighting affected the relative chlorophyll content as well as stomata size in banana plantlets in vitro. LEDs at 90 µmol m^{-2} s^{-1} were identified to be a suitable selection for the micropropagation of ornamental bananas.

Some interesting aspects of the seeds of the succulent species *Suaeda aralocaspica* were found by Si et al. [4]. The authors demonstrated that the highest germination percentage

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of brown seeds was 100% and that of black seeds was 17%. Thus, brown seeds were more suitable for further culturing experiments than black seeds. For brown seeds, the sterilization effect of NaClO was better than that of $HgCl_2$. Rinsing with 75% ethanol for 60 s, sterilizing with NaClO for 8 min, and cultivating at pH 8.0 MS for 7 days was the best of all sterilization procedures and cultivation methods tested, which has been successfully applied to in vitro *S. aralocaspica* cultures.

Another important horticultural species, i.e., vanilla (*Vanilla planifolia*), was studied by Serrano-Fuentes et al. [5]. The authors tried to induce somaclonal variation in V. planifolia through gamma radiation and detected it by using inter-simple sequence repeat molecular markers. The results showed a hormetic effect on the explants, promoting development at a low dose (20 Gy) and showing inhibition and death at high doses (60–100 Gy). The LD50 was observed at 60 Gy. The primers UBC-808, UBC-836, and UBC-840 showed the highest % P, with 42.6%, 34.7% and 28.7%, respectively. Genetic distance analysis showed that treatments with and without irradiation produced somaclonal variation. The use of gamma rays during in vitro culture was shown to be an alternative method to broaden genetic diversity for vanilla breeding.

In vitro experiments were conducted by Hanász et al. [6] to study the responses of potato (*Solanum tuberosum* L.) genotypes to osmotic stress. In vitro shoot cultures of 27 breeding lines and their drought-tolerant parents were tested under osmotic stress induced by the addition of PEG 6000, D-mannitol, and PEG 600 to the Murashige–Skoog medium. It was demonstrated that 7.5% and 10% PEG 6000 or 0.2 M and 0.3 M D-mannitol treatments are suitable for the selection of osmotic stress-tolerant potato genotypes.

Hadi et al. [7] provided the first report on the development of an in vitro propagation protocol for seed germination and somatic embryo formation from seeds of the threatened endemic medicinal plant species, *Aconitum violaceum*. The authors found that that seeds are suitable explants for efficient multiplication and restoration of A. violaceum within a short period of time, approximately three to 5 months, starting from the initiation of seed germination or somatic embryo development to final tissue culture-raised plantlets.

Interesting results were also reported by Khuat et al. [8] using black cardamom (*Amomum tsao-ko*). They aimed to improve the seed germination rate and uniform germination through mechanical scarification, immersion in hot or cold water, acid scarification, and the application of plant growth regulators. Applying mechanical scarification treatment before sowing was shown to be the most effective for improving seed germination rates. Immersion in cold water or plant growth regulators before sowing were also recommended. Finally, the authors described that the developed in vitro propagation protocol is an effective solution for rapid multiplication of high-yielding elite plants to meet the needs of expanding cultivation of this important crop.

A high-performance in vitro propagation system for *Plectranthus amboinicus*, a medicinally important aromatic perennial herb, was investigated by Faisal and Alatar [9] through direct shoot organogenesis. The system was developed using axillary node explants cultured on MS medium augmented with various plant growth regulators. The authors found that after 8 weeks of culture, the explants cultured in full-strength MS basal medium (pH 5.7) with 5.0 µM BA and 2.5 µM NAA exhibited the highest percentage of regeneration and the maximum number of shoots per explant. Individual elongated shoots were rooted on half-strength MS basal medium containing 0.25 µM IBA after 4 weeks of culture.

Nasrat et al. [10] assessed the effect of induced calluses of the medicinal herb *Bougainvillea glabra* in vitro under different light conditions and plant growth regulators and measured their phytochemical and antioxidant activities using different extraction solvents. The maximum number of days to callus initiation were recorded when nodal explants were cultured on woody plant medium supplemented with 7.5 µM 2,4-D + 0.5 µM BAP under light conditions. On the contrary, the minimum number of days to callus initiation was obtained when nodal explants were treated with 2.5 and 5 µM 2,4-D + 1 and 1.5 µM BAP under dark conditions. In addition, an aqueous extract of conventionally propagated nodal explants exhibited the highest phenolic content and antioxidant activities.

Another interesting result was obtained by Dewir et al. [11] who compared in vitro flower induction and the formation of daughter corms of saffron (*Crocus sativus*) in gel and liquid cultures. Additionally, different concentrations of glutamine, salicylic acid, and jasmonic acid were tested with the aim to improve the formation of saffron daughter corms. It was demonstrated that saffron flowering could be induced in vitro, and the harvested stigma of these flowers could be used as a source of spice or pharmaceuticals. Compared with solid culture, liquid cultures/bioreactors improved daughter corm diameter and fresh weight. Moreover, salicylic acid at 75 mg L^{-1} and glutamine at 600 mg L^{-1} increased corm diameter and fresh weight.

Sand [12] reviewed the main results of experiments conducted on Syngonium *podophyllum*, which is recognized as a valuable ornamental and medicinal species, between 1996 and 2004 and published after 1998, to provide new insights specifically related to de novo shoot formation from callus. The author described the lessons learned from all experiments performed on Syngonium—including the principles to implement industrial-scale micropropagation—and may further support the production of phenolic compounds relevant for in vitro systems at the industrial scale.

Moving towards another crop species, *Morus alba*, also known as mulberry, Chen et al. [13] conducted a trial to clarify the inherent mechanism of cutting rooting, and to explore the relationship between growth hormones and endogenous hormones. The plant growth regulators IAA, IBA, and ABT-1 were able to promote the rooting of cuttings of vegetable mulberry and fruit mulberry, with ABT-1 exhibiting the best effect.

Finally, Nascimento et al. [14] estimated the adaptability and the temporal stability of strawberry (*Fragaria ananassa*), as well to select genotypes that are easy to propagate with lower cold requirements using a mixed linear model. Through this model, the authors showed the superiority of 11 genotypes that had the potential to be released as cultivars. The strawberry RVFS07M-34 was the most promising genotype to be registered as a new cultivar.

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