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Morphological and Biotechnological Aspects of Gladiolus

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Gladiolus (family *Iridaceae*) is a significant cut-flower crop in India, valued for its elegant diversity and economic importance. The article reviews the botanical traits and propagation developments of the species. A comparative investigation indicates that traditional corm-based farming experiences issues with disease susceptibility and limited multiplication, whereas Plant Tissue Culture (PTC) presents a more advantageous option, enhancing propagation rates by as much as 100-fold. The combined knowledge of biotechnological techniques with optimized plant growth regulator (PGR) methods is crucial for the prospective growth of the Indian Gladiolus sector.

Botanical Profile and Cytogenetic Complexity

The genus Gladiolus, a well-known member of the *Iridaceae* family and subfamily *Crocoideae*, has over 180 species, most of which are found in tropical and South Africa. *Gladiolus grandiflorus*, sometimes known as the "Sword Lily," is a perennial herbaceous plant that stands out for its unique subterranean storage organs called corms. Depending on the cultivar, these corms produce ensiform foliage and terminal spikes that can grow up to 60–150 cm in height. The genus's complex cytological profile, which ranges from the basic diploid (2n=30) to diverse polyploid levels ranging from 60 to 130, is one of its most physiologically significant characteristics. The production of contemporary "Grandiflorus" hybrids has been greatly aided by this genetic adaptability, as polyploidy is frequently associated with larger flowers and more substantial petals.

Standardization of Micro-propagation and PGR Optimization

Explant Establishment and Phenolic Management

The crucial selection of terminal or axillary buds from dormant corms is the first step in the technique. Corms have a high microbiological load since they are subterranean constructions, necessitating a thorough multi-stage sterilizing process using 70% ethanol and 0.1% HgCl2. The control of phenolic leaching, which results in oxidative browning, is a technical basis of this standardization. For ensuring high initial survival rates, known methods include pre-soaking explants in an antioxidant solution of ascorbic and citric acid and adding activated charcoal (0.5%–1.0%) to the basal medium (Kumar et al., 2024).

Review of Literature: Hormonal Dynamics and PGR Standardization

A precise physiological balance between auxin-induced organogenesis and cytokinin-mediated proliferation is highlighted in the literature on PGR standardization in Gladiolus micropropagation. 6-Benzylaminopurine (BAP), which Kumar & Mishra (2012) standardized at concentrations between 2.0 and 5.0 mg/L for optimum shoot turnover, is essential to the initiation and multiplication stages. According to their results, concentrations above 8.0 mg/L often cause hyperhydricity, a physiological condition marked by brittle, water-soaked tissues, highlighting a key threshold. Kumar et al. (2024) showed how adding Gibberellic Acid

(GA3) at 0.5 mg/L as a synergistic elongating agent efficiently overcomes the dense, stunted clusters usually generated by BAP alone in order to reduce these morphological limitations.

Hormonal signals must change in a regulated way as the plant undergo to the rooting phase. As the plant develops into the roots period, hormonal signals must shift in a regulated manner. While various auxins are utilized, it was found that for cultivars such as 'Pusa Shagun', Indole-3-butyric Acid (IBA) at 1.0–2.0 mg/L is more effective than Naphthaleneacetic Acid (NAA) because it promotes a more robust, branched fibrous root system without the formation of unwanted basal callus. Moreover, the uniform induction of micro-cormels reflects a coordinated shift in metabolic activity (Liu et al., 2020, Li et al., 2021).

According to Li et al., 2021, starch accumulation depends on the interaction between high sucrose concentrations (6%–9%) and growth retardants, particularly Paclobutrazol at 0.1–0.5 mg/L. By preventing vertical vegetative growth and diverting metabolic energy into the swelling of the basal node, this combination successfully inhibits gibberellin biosynthesis, insuring the production of robust, high-quality storage organs suitable for field transplantation in a variety of agroclimatic zones like Gujarat.

Economic Impact and Phytosanitary Management

A higher Benefit-Cost (B:C) ratio—estimated between 2.5 and 3.2 for tissue-cultured materials compared to 1.8 for conventional farming—is the primary reason for the move toward biotechnology propagation. In addition to yield, micropropagation assures a virus-free state, which is essential in areas where viral diseases like Thrips (Taeniothrips simplex) are common. Sustainable production requires Integrated Pest Management (IPM), which combines bio-fungicides like Trichoderma viride with certified virus-indexed plantlets (Raj et al., 2021).

Conclusion

For the Indian floriculture industry, the cultivation of Gladiolus represents a high-potential frontier. To meet international quality standards and address corm scarcity, advanced micropropagation protocols and PGR applications must be standardized. The Gladiolus industry can attain sustainable economic growth by bridging the gap between experimental innovations and field applications.

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