

ROLE OF TAILORED LED SPECTRA ON *IN VITRO* CULTURE OF MEDICINAL PLANTS

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Purpose: Light conditions are among the most important physical factors affecting the establishment and development of plant *in vitro* cultures. The study aimed to evaluate the influence of tailored LED spectral combinations on culture initiation, shoot proliferation, biomass accumulation, and rhizogenesis in medicinal and aromatic plants cultivated *in vitro*.

Materials and methods: The analysis was performed under controlled *in vitro* culture conditions using a photoperiod of 16 h light/8 h darkness and approximately 3000 lx light intensity. LED systems combining blue (450-495 nm), green (495-570 nm), yellow (570-590 nm), red (620-750 nm), and far-red/infrared light (700-800 nm) were considered. The effects of spectral combinations on explant adaptation, morphogenesis, culture establishment, shoot multiplication, root induction, and biomass accumulation were evaluated in medicinal and aromatic species including *Aronia melanocarpa*, *Mentha piperita*, *M. citriodora*, *Lavandula angustifolia*, *Origanum vulgare*, and *Stevia rebaudiana*.

Results: Blue light promoted cell division, chlorophyll formation, and improved explant adaptation during the early stages of culture establishment. Red light enhanced shoot proliferation and biomass accumulation through phytochrome-mediated responses, supporting efficient micropropagation. Green light contributed to modulation of physiological processes associated with culture initiation and development through improved radiation penetration into internal tissues. Combined red–blue–green spectra exhibited a pronounced stimulatory effect on micropropaga-

tion in *A. melanocarpa*, *Mentha* spp., and *S. rebaudiana*, leading to improved shoot multiplication and biomass development. Under continuous light conditions with an 8/16 photoperiod regime, enhanced rhizogenesis was observed particularly in *A. melanocarpa*, *Mentha* spp., *L. angustifolia*, and *O. vulgare*, indicating improved root induction and subsequent plantlet establishment. In contrast, yellow light slowed both micropropagation and rhizogenesis processes across all studied species, suggesting a lower stimulatory capacity for morphogenetic responses. Far-red/infrared light showed no pronounced stimulatory effect on culture initiation and proliferative responses under the tested conditions, while its potential may influence on secondary metabolite accumulation requires further investigation. Moreover, optimized multicomponent LED spectra improved coordination between shoot proliferation and rhizogenesis, increasing the potential for obtaining vigorous plantlets with enhanced acclimatization capacity. Tailored LED combinations promoted more efficient culture initiation, improved shoot multiplication rates, and stimulated rhizogenesis, resulting in better development of complete plantlets suitable for acclimatization.

Conclusions: Optimization of LED spectral combinations represents an effective strategy for improving *in vitro* culture initiation, micropropagation efficiency, and rhizogenesis in medicinal plants. The effects of individual LED spectra were species-dependent and associated with distinct morphophysiological responses.

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