

Whitepaper FDM

**PHOTOBIOLOGY: OPTIMIZING LED LIGHTING SYSTEMS IN GROWTH CHAMBERS**

## Executive Summary

LED lighting systems are transforming plant research and controlled-environment agriculture. By precisely tuning light spectra, intensity, and photoperiod, researchers can mimic natural conditions, influence plant metabolism, and improve experimental reproducibility. This whitepaper offers a practical guide to setting up, calibrating, and maintaining LED lighting in growth chambers.

---

## Key Setup Parameters

The performance of LED lighting systems depends on the correct configuration of several factors:

### 1. Light Spectrum (Wavelength Range)

- **PAR (Photosynthetically Active Radiation):** 400–700 nm
  - **Red (660 nm):** promotes flowering and photosynthesis
  - **Blue (450 nm):** encourages vegetative growth
  - **Far-red & UV-A:** optional for stress or flowering studies
- Customizable LED arrays allow precise spectral balancing based on species and growth stage.

### 2. Light Intensity and Uniformity

- **Recommended intensity:** 150–500  $\mu\text{mol}/\text{m}^2/\text{s}$  depending on crop type
- **Uniformity:**  $\pm 10\%$  across chamber surface to ensure reproducible growth
- **Control:** dimmable drivers and programmable cycles for day/night simulation

### 3. Thermal and Humidity Interaction

LEDs generate less heat than traditional lamps, but chamber integration must consider:

- Airflow management
  - Heat dissipation systems
  - Synchronization with temperature and humidity controls
- 

## Maintenance and Calibration Best Practices

- **Routine check of intensity levels** using a PAR sensor
  - **Cleaning schedules** to remove dust and condensation from LED lenses
  - **Verification of spectral stability** every 6–12 months
  - Integration with control software to adjust for light degradation over time
- 

## Case Study: Enhancing Growth of Medicinal Plants

A European research team installed a fully programmable FDM LED chamber to study the effects of spectrum variation on secondary metabolite production in basil and echinacea. Using blue:red ratios

of 1:3 and 16-hour photoperiods, they achieved a 35% increase in active compounds, while maintaining chamber stability at 25°C and 60% RH.

---

## **Conclusion**

LED lighting in climate chambers enables advanced photobiology experiments with high precision and energy efficiency. FDM's chambers are fully customizable, offering control over light spectra, intensity, and integration with environmental parameters. This supports innovation in plant science and commercial agriculture alike.

**CONTACT US FOR EXPERT CONSULTATION**

**[SEND EMAIL](#)**