ABS-00375

Influence of glazing materials on plants and the conditions inside greenhouses in botanical gardens

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Keywords: greenhouse, glazing materials, light conditions, material degradation, solar radiation transmittance, daylight simulations

Our research focuses on the influence of various cladding materials on the quality of greenhouses in botanic gardens. Utilizing Rhinoceros 3D, we created digital 3D models of greenhouses with different glazing materials and conducted simulations of light conditions both outside and inside these structures. Our study specifically targeted the Tropicana greenhouse in the Teplice Botanic Garden. We tested various materials, including single-pane glass, double-pane glass, triple-pane glass, single-layer ETFE foil, double-layer ETFE foil, triple-layer ETFE foil, and multiwall polycarbonate of 4 mm (with two walls), 16 mm (with three walls), and 32 mm (with seven walls). A key aspect of our research was comparing these materials in terms of their variability over time, specifically focusing on the degradation of each material and the reduction of solar radiation transmittance of the glazing material. The data obtained were then compared with the requirements of plants for light, thereby demonstrating the compatibility of individual greenhouse glazing materials with the plants inside them. Our results contribute significantly to understanding how botanic gardens can more effectively use various materials for greenhouse glazing to achieve optimal conditions for plant growth while minimizing their environmental impact.