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学 位 記 番 号	千大院園博甲第農１５６号
学位記授与の日付	令和６年９月３０日
学位記授与の要件	学位規則第４条第１項該当
学 位 論 文 題 目	Evaluating plant canopy microclimate using computational fluid dynamics in a plant factory with artificial light 数値流体力学（CFD)を用いた植物工場における植物群落微気象の評価
論 文 審 査 委 員	（主査）准教授　彦坂　晶子 （副査）教　授　後藤　英司　　教　授　松岡　延浩 准教授　淨閑　正史

論　文　内　容　の　要　旨

The microclimate of plant canopies is important to plant growth and development in plant factories with artificial light (PFALs). The distribution of the microclimate is sensitive to airflow and plant transpiration in cultivation shelves of PFALs. Therefore, simulating the distribution of microclimate and plant transpiration by a computational fluid dynamics (CFD) model with realistic plants will provide valuable insights into optimizing airflow control.

In Chapter 1, a general introduction including the background on plant canopy microclimate, transpiration model, CFD in simulating plant canopy microclimate and transpiration, and the objectives of this study are described.

In Chapter 2, a CFD model with realistic plants was developed to analyze the airflow in plant canopies. Results demonstrated that the airflow of plant canopies was significantly improved by high inflow velocity and slightly enhanced by staggered plants. Additionally, airflow was hindered by plant growth and leaf veins. In conclusion, inflow conditions were critical for influencing airflow in plant canopies.

In Chapter 3, a CFD model with realistic plants was developed to analyze the microclimate of plant canopies under different inflow parameters. Results demonstrated that inflow velocity and temperature notably influenced lamp and leaf temperature. Additionally, inflow velocity, temperature, and humidity exerted more significant effects on air velocity, temperature, and humidity around plants, respectively. Furthermore, inflow velocity notably enhanced airflow parameter uniformity of plant canopies. It's suggested to set different inflow velocities at lamp and canopy locations. High levels of inflow velocity and medium levels of inflow temperature and humidity contrast control targets are recommended.